

A PRAGMATIC APPROACH TO THE FUNCTIONAL ANALYSIS OF CHIPPED STONE TOOLS

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I declare that this thesis is my own composition and is based upon my own work.

W.L.Finlayson

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A pragmatic approach to the functional analysis of chipped stone tools.

Abstract:

The analysis of stone tool function has been an important and growing area of research since the 1960's and the publication of Semenov's research in English (Semenov 1964). Most research has recently concentrated on the "High Power" method of microwear analysis developed by Keeley, which concentrates on the microscopic polishes that develop on tools during use. It is assumed that these polishes have a high correlation with individual worked materials (Keeley 1980)

It was initially hoped that these polishes could be studied using image processing techniques. However, it was discovered that individual materials did not have a satisfactorily high correlation with polish "types" to justify the expense of such a technique. This was established by a theoretical analysis of the formation of wear traces, by the experimental programme undertaken and by the analysis of "blind test" results. This result was supported by other analysts conducting similar research at the same time (cf Grace 1989). In addition the small samples analysed by the "High Power" method were seen as inadequate for the generalised questions being asked by functional analysts.

A new method of analysis was developed that concentrated on accuracy rather than the high precision of the "High Power" method. It was considered that this method, although not producing such specific interpretations for individual tools, produced more reliable information that was suited to the types of question that functional analyses should be able to answer. It also allowed the analysis of a number of tool materials that were too coarse and irregular for detailed polish analysis.

Several case studies were conducted. Most of the material examined was from Mesolithic sites in Scotland. It is shown that the functional technique provides useful information, indeed that without the functional evidence it is hard to make full sense of the lithic data. At the same time it is shown that the functional aspect is only a part of the lithic evidence, and that all parts have to be used in combination. The evidence is considered in this way to present a working hypothesis for Mesolithic socio-economics in Scotland.

The two case studies from beyond Scotland are both more limited pieces of analysis. They both demonstrate how functional analysis can be used as a technique to test specific theories, and both demonstrate how a simplistic use of conventional typology involves dangerous assumptions concerning function.

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The late Tom Affleck provided much inspiration. He had an infectious enthusiasm for the Mesolithic in Scotland, a subject that I had previously had little awareness of. He freely supplied me with material from his excavations, which both helped to illustrate the failings of my original approach and provide motivation for my second attempt.

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Glossary:

Edge Damage: the scarring and snapping of a tool edge that occurs as the result of any means apart from the deliberate retouching of a tool

Functional Analysis: the study of stone tool functions, by whatever means possible

HP: the High-Power method of microwear analysis developed by Keeley

Image Analysis: the analysis of images by computer

LP: the low-power method devised by Tringham and developed by Odell

Microwear analysis: the subset of functional analysis that concentrates on microscopic evidence

NUW: Non-Use-Wear: traces that are not the result of either use, or the obvious result of manufacturing processes.

Opp Use: marginal use, probably the result of incidental, opportunistic use of a tool

Polish: a smoothing of the original surface of a tool

SEM: scanning electron microscope

Striations: scratch marks through a polish surface

Computing:

The software used to produce this thesis was all run on IBM PC/AT compatible machines in the Department of Archaeology. The wordprocessing package used was Microsoft Word, the database package was Borland's Paradox, and the spreadsheet was Borland's Quattro.

Part 1

Method and Theory

"When it happened I now know not; but having this find one day in my hand, while in an enquiring mood, illumination came. I had grasped it with my right hand by the back-like side toward the broad end ... and the word "flayer" came to me; *they were flayers.*" (Rev Frederick Smith 1909: 154)

1: Background and Project Design

For over 2,000,000 years man has been making tools, and for over 99% of that time the only ones that survive in any number are those made of stone. While there is little doubt that tools made from organic materials, such as wood and bone, were made and used at an early stage, possibly even before stone tools, they are not preserved (Crabtree 1972). Organic tools are only recovered in any number from the Upper Palaeolithic onwards. Materials other than stone (for example ceramics and structures) only begin to be significant evidence for human activity from the Neolithic onwards. While much material culture may be organic, it only survives in special circumstances.

The importance of stone tools for the study of prehistory cannot be understated. The tools are studied directly by means of typologies based on morphology and technology, by studies of the technology revealed through the 'waste' materials of stone tool manufacture and maintenance, and by studying the strategies of reduction through the re-assembling (refitting) of cores. The tools are used indirectly to study the size of settlements, the potential separation of activity areas and many other matters increasingly removed from the tools themselves. Researchers have always been interested in the function of stone tools and implicit in many studies are functional assumptions. With notable exceptions such interests have rarely (until recently) made much use of the evidence on the tool itself.

The field of functional, or 'microwear', analysis has over the last 20 years been a major area for optimistic research in lithic studies. Prior to the publication in English of Semenov's *Prehistoric Technology* (Semenov 1964), the subject had been approached by many, but not as anything other than a minor study, the subject for an occasional paragraph, or short article. Since the publication of Semenov's work the field has grown rapidly, with several different and competing methods emerging.

Common to the different approaches is the comparison of the visible traces left on a tool (damage to the tool edge, scratch marks and polishing) with the traces left on replica pieces used experimentally in known ways on known materials. A few analysts look for residues of worked materials.

This project was begun in the light of the exciting developments emerging from the research, particularly from the work of Keeley and the 'High Power' approach, concentrating on the polishes formed during use (Keeley 1977). Since that beginning the field has started to mature, and the hopes and claims of the techniques of functional analysis have been moderated by pragmatism, although controversy still exists between scholars. The study of stone tool function has, as a result, come under criticism, much undoubtedly deserved. It is to be hoped that the large number of scholars currently working in this field are now trying to deal with the problems of accuracy, sample size, and purpose of their research. It has been stated that functional analysis "after a good start, must be developed further - as is often the case." (Mueller-Beck 1986: 3). As so often happens in the expansion of a new area of research, too much emphasis has been placed on that element of research itself, rather than in paying heed to the wider concerns of the discipline of which the new technique is only a part. In addition, the power of the method itself has perhaps been exaggerated. What is now needed is a more realistic use of the method. This realism has to occur both in the internal workings of the method, and in its application to archaeological problems.

"Each new study of this type results in the generation of more facts from the site, but *they are all statements about the archaeological record alone*. In the absence of robust methods for inference, all that can be accomplished is the gathering of more and more facts, whose significance in terms of past behaviour is unknown. These facts are commonly interpreted using the method of 'multiple working hypothesis' - put baldly, we recognise that things might have been this way or that way and we exercise judgement as to which appears the more plausible." (Binford 1983: 76)

Background to research aims:

The original research design for this project was to develop a method using digital image processing techniques to enable polishes to be quantified objectively. It was hoped that this technique would have several advantages in that it would allow microwear analysts to avoid subjective descriptions of polish, such as "a melting snowbank" (Keeley 1980: 56), and to replace them with quantified descriptions. This quantification would allow greater accuracy. The separation of polish types would also permit a measure of automation in microwear analysis that would enable larger samples to be examined in the time available. The use of the technique was to be tested with a number of widely varying case studies.

These hopes were impeded by a number of problems. One major problem that delayed progress was that the image processing facilities (both equipment and advice) that had been arranged in advance of the project became unavailable. This was due to increased financial pressure on the institute concerned. (This problem was to occur once more during the course of the project. This type of difficulty influenced later decisions, and the importance of financial aspects became clearer than if no such problems had occurred.)

While these difficulties were being resolved a more serious problem arose. The basis for this study was the assumption that varying polishes found on tools were indicative of the different materials worked in different fashions, following the work of Keeley. The experimental programme of tool use that was being conducted in this research project was producing evidence that a much more complicated picture existed. When tools of chert from the Scottish Southern Uplands were incorporated into the study, the difficulties in using a method of analysis that treated polish as the primary (if not the only) evidence became insurmountable.

The research design:

A new research design was constructed which started very much from first principles. In retrospect the original design was seen as having been excessively 'method-driven', and a more flexible approach was considered desirable. It was found that a wide range of attributes had to be considered, ranging from gross tool morphology to traces only visible under high power magnification. Polishes became only one of many features considered. The term 'microwear analysis' was no longer appropriate to the study, and the broader term 'functional analysis' has been adopted instead. Image processing was initially relegated to a research tool to examine the varying polish textures and finally abandoned as a suitable method in the context of the materials studied and the approach developed. The level of interpretation was in general lowered, as both 'blind tests' and experimental work suggested that this produced more reliable results. The case studies envisioned in the earlier design were retained in order to examine how readily the new method could be applied to a wide range of materials, and to examine how useful the new, less specific, analysis could be.

A prime objective of both the original and the new research designs was to create a practical method for the study of stone tool function. Following on from this basic aim the following criteria are important:

- 1: Time: The time taken to examine individual tools has to be as short as possible, to allow adequate samples to be analysed within project constraints of time and money.
- 2: Cost: The use of expensive techniques was avoided unless the information gleaned from their use could be justified. (These techniques include the Scanning Electron Microscope and Image Processing. This criterion was a prime reason for reducing the importance of image

processing techniques, in addition to the practical problems involved.)

3: Reliability: Problems were observed in the detailed interpretation of tool functions. It appeared that much functional analysis attempted to go too far in its interpretation, making it not only unreliable, but also damaging the reputation of functional analysis, thereby reducing its credibility in general. All functional analysis techniques infer function by analogy. Over-confident and over-precise interpretations suggest that functional analysis is an absolute science and lead to the pursuit of 'all or nothing' solutions.

4: Purpose: Producing catalogues of used tools serves little archaeological purpose. The aims of a functional study have to be clearly defined.

The first three criteria are clearly practical, the fourth is equally important, but more theoretical. It is hoped that this project provides a technique that fulfils the requirements of practicality.

The fourth criterion, 'Purpose', is as important to functional analysis as the basic practicalities. Although much has now been written on the subject

"Up until recently, publications have stressed the *possibilities* of microwear analysis...Research on method and theory are now necessary to assess the realistic possibilities of functional lithic determination." (Owen and Unrath 1986: 11, my emphasis)

The lack of any clearly defined purpose in much wear research, other than testing the method, is seen here as a serious problem. It is hard to develop a technique if the practical uses of it are unclear.

The term 'functional analysis' has been used to describe the study undertaken here. Brown and Edmonds have suggested that this is a poor title to use, as the word function implies a "holistic approach to the role of lithics involving statements about purpose and intention." (Brown and Edmonds 1987: 4) They prefer to retain the term 'microwear analysis', despite the implicit limitations on the evidence used. It will be argued in this study that the functional approach must be made in a holistic manner for it to have any value at all. Isolated statements about tool use are of limited value, and have little explanatory power (Bonnichsen 1977: 3). Simple description of wear traces, or lists of interpreted wear traces, do not advance our understanding of prehistoric society.

The case studies are concerned with a range of tool materials, all with poor or irregular flaking properties. Formal tool typology is in many ways not suited to the study of these materials as it assumes a degree of regularity not always possible with such materials. The assemblages show a wide range of variation. As a result reduction strategies varied, producing at one extreme fine bladelets and at the other irregular chunks. Only by adopting a holistic approach, examining the relationships between material, typology, technology and function can these assemblages be adequately studied.

Design of thesis:

The thesis is divided into three parts:

Part 1, method and theory, discusses the development of functional analysis, presenting a brief review of the techniques used and the theoretical basis of functional analysis.

Part 2, the pragmatic use of functional analysis, discusses the purposes of functional analysis, the development of the technique used to achieve these purposes and the experimental programme conducted.

Part 3, case studies, discusses a series of case studies which illustrate the application of the method developed in Part 2. These studies can be divided into two sections; the first examines three Scottish Mesolithic sites, Smittons, Starr and Gleann Mor. The second examines two sites in the Near East, Kissonerga Mosphilia, a Chalcolithic site in Cyprus, and Jebel Naja, a late Neolithic site in Jordan, to test whether the approach is successful in its attempt to be widely applicable and useful.

The primary data produced during the course of this research is presented in a number of appendices; this should enable other researchers to examine the evidence, and assess the interpretations given.

2: The Development of Functional Analysis

There is now a large body of literature on the subject of the functional analysis of stone tools, much of which is useful. It is not necessary to discuss every publication. Some are reports which present only the results of a study without giving details of the method used, and are therefore, of limited value. Most of the important information can be gleaned from a relatively small number of texts. Here an outline of early interest in stone tool function, details of some major developments and a summary of current research will be presented. Olausson (1980) gives a general (and somewhat optimistic) review of the history of functional analysis between 1838 and 1978. Other reviews of functional research include Vaughan (1981) who gives a summary of the last 150 years development. Cook and Dumont (1987) give a review of developments since 1964. Juel Jensen (1988) gives the most recent review of West European research, which, unlike most other studies, is concerned about the purpose of functional analysis. As this study is concerned with chipped stone tools, the study of ground stone tools will not be discussed. Critical analysis of the works mentioned in this section will be brief. A more detailed discussion of the elements that are of particular relevance to this work will be found in later sections as appropriate.

Early Developments:

The earliest recorded investigation of function by examining how a tool has worn occurs in the late 1830s with Nilsson's work (cited by Olausson 1980: 48). Ruth Tringham has reported on some of the earliest approaches to the functional analysis of stone tools that have any bearing on modern studies (Tringham *et al* 1974). She quotes at some length from John Evans and the quotation is repeated here. Although written over one hundred years ago, the passage remains a remarkably good summary of some of the aspects of wear on used tools.

"Each flake when dextrously made, has on either side a cutting edge, so sharp that it might almost ... be used to shave with. As long as this edge is used merely for cutting soft substances it may remain for some time comparatively uninjured...If the flake has been used for scraping a surface, say, for instance, of bone or wood, the edge will be found to wear away, by extremely minute portions chipping off nearly at right angles to the scraping edge, and with the lines of fracture running back from it. The coarseness of these minute chips will vary in accordance with the amount of pressure used, and the material scraped, but generally speaking, I think I am right in saying that they are more delicate and at a more obtuse angle to the face than the small chipping produced by the secondary working of the edge of a flake...In all cases where a considerable number of flakes of flint occur...a greater or lesser portion of them will, on examination, be found to bear these signs of wear upon them..."(Evans 1897: 289)

This passage is directly relevant to Tringham's own work, for the evidence it uses is very much the core of what has become known as the "Low Power Approach". She does however omit a statement that was perhaps less relevant to her approach, although of interest now that polish is a matter for considerable debate.

"If long in use, the sides of the blade become polished by wear..."(Evans 1897: 289)

In the same work Evans continues to lay down the basic theory of functional analysis. His approach is soundly based, looking at the evidence from the tools in question, rather than proceeding first to analogy.

"...before entering into the question of the purposes which implements of the "scraper" form were in ancient times intended to serve, it will be well to examine the evidence of wear afforded by the implements themselves. This evidence is various in its character, and seems to prove that the implements were employed in more than one kind of work."(Evans 1897: 311)

He goes on to describe, in some detail, the traces on various classes of scraper. Evans' observations were apparently supported by experimental work.

"The wearing away of the edges of many of the flint flakes is precisely of that character which I find by experiment to result from scraping bone." (Evans 1897: 504)

Evans also reports the experiments conducted by other researchers. The only flaw is that these lack the more rigorous and disciplined approach now expected, but it must be remembered that this element only represents supplementary information in Evan's book, which does not pretend to be a work of functional analysis.

The origins of the "High Power Approach" can perhaps be seen in Curwen's work in the 1930s and 40s, where he began to examine the presence of polish on the working edges of tools.

"In order to investigate the matter afresh the present writer obtained a series of newly made serrated flakes of black flint from Fred Snare of Brandon, the serrations being coarse in some and fine in others. Separate flakes were used for cutting wood, dry bones and corn stalks in the form of bottle straws." (Curwen 1930: 184)

In 1935 Curwen recorded a series of experiments to produce polish in a controlled manner, by using two different kinds of flint, applied with sufficient pressure to cut into cylinders of oak, bone and compressed straw (strawboard), spun on an electric lathe. He recorded time and revs per minute. The tools were carefully washed with brush, water and grease solvent. The results varied according to flint type and silica content and degree of yield in the worked material. He points out that different tasks produce different results - sawing wood with shallow penetration causes a narrow polish, while axing wood with deep penetration produces a penetrating polish (Curwen 1935). While we might not regard these as truly rigorous experiments by today's

standards, they do perhaps foreshadow Newcomer's call for this sort of work (Newcomer *et al* 1986), and Sala's experimental work on the controlled production of polishes by contact with various materials (Sala 1987).

2.3: Semenov:

More widely known is the work of Semenov in the USSR. In 1964 his book *Prehistoric Technology* (Semenov 1964) was published in English. Although his research started in the 1930s (at the same time as Curwen was conducting his experiments) it represents a major methodological advance in functional studies. By 1957 (when the Russian edition of his work was published) he had undertaken a massive experimental study on the use of stone (and bone) tools, to test the relationship between varying uses and different worked materials in a systematic manner. This allowed him to compare the wear produced on experimental tools with that found on archaeological material. The scale of his experimental work, combined with his systematic method of analysis, demonstrated the potential of functional analysis for prehistoric archaeology. At the same time it caused a new sphere of archaeological research to come into being as a rigorous sub-discipline. The rise in interest in functional analysis in the West following the translation of his book into English (Semenov 1964) is a testimony to the importance of his work.

Developments in the West:

The first developments following Semenov's work were either very limited in scope (for example tool efficiency studies (Keller 1966)), or fell short of the standards now expected of such work. Very often key data was omitted from the publications and essential background work was not performed. Keeley (1974) gives a criticism of the work carried out during this period. The major works of importance that did occur can be divided into two major lines of approach: the "Low Power" (Tringham *et al* 1974, Odell 1974, 1983, Odell and Odell-Vereecken

1980) and the "High Power" (Keeley 1977a, 1977b, 1978, 1980, Keeley and Newcomer 1977, Keeley and Toth 1981).

The "Low Power" Approach:

This method of study, frequently now perceived as a less useful method than the "High Power" approach, is based primarily on the study of edge damage. It claims to be faster than the "High Power", allowing far larger samples to be analysed, and also cheaper due to the lower magnifications used (less than 100x) (Odell and Odell-Vereecken 1980). The disadvantage of the approach is that it does not give such detailed information as the "High Power", particularly with regard to the identification of the raw material worked.

The "High Power" approach:

Keeley's work on polish identification using much higher magnifications than the "Low Power" method (commonly 100x for scanning a tool surface and 200x for identification of polishes) has attracted a great deal of attention. Keeley claimed to be able to identify the material worked from the polish developed on the tool, be it hide, bone, wood, or other material. A "Blind Test" was conducted with Mark Newcomer to examine the accuracy of Keeley's identification, and the results were taken by many to demonstrate the validity of his method. (For a discussion on "Blind Tests" and their results see below, chapter 4.) This method is claimed to be capable of producing far more information on prehistoric economy, site activities and so on, than the "Low Power" approach. Therefore, most recent research has been conducted within the framework of polish identification at high magnification.

For convenience the "Low Power" approach will be referred to as the LP approach, and the "High Power" approach as the HP approach.

Non-Flint Materials:

Functional analysts have now studied a wide range of chipped stone materials. Most of these have been treated as variations of flint, but a number of the materials behave differently. Some of the studies conducted include those on obsidian (Vaughan 1981, Hurcombe 1986), basalt (Plisson 1982, Odell and Odell-Vereecken 1980), slate (Akoshima 1987), porphyry and 'halleflint' (Knutsson and Taffinder 1986), quartzite (Plisson 1986) and quartz (Broadbent and Knutsson 1975, Broadbent 1979, Knutsson 1988). While the specifics of these studies are tangential to this paper, it is fair to say that much useful information has come out of them that is of general utility. Perhaps the most important aspect is the greater caution shown by analysts when dealing with these less familiar materials, an approach which should be adopted in all functional analysis.

Recent research and developments:

There is now a large body of scholars working in the field of stone tool functional analysis. There have been many developments in approaches, although most methods are clearly based on Keeley's work. These developments have included the use of new analytical techniques and equipment, increased experimental work, and an appreciation of the difficulties of functional analysis. They will be discussed in full in chapter 3.

Indirect methods of functional analysis

There have been studies made of the function of stone tools which have not used the direct evidence on the tools for function, apart from some reference to basic tool morphology. Two of the most prominent are mentioned here.

Binford and Binford:

Ironically, shortly after the translated version of Semenov's work became available, Binford and Binford (1966 and 1969) produced an examination of the co-variance of Mousterian tools. This was an entirely statistically based approach to the study of function. The suggestion was that:

"if similar or identical patterns of co-variation among similar tool classes could be shown to cross-cut recognisably different assemblage 'types', then the probability would be high that the assemblage types derive their consistent associational patterning from the organised distribution of stimuli, and not from the differential distribution of distinct cultural repertoires among population segments. "(Binford 1973 228)

This argument was debated at length in the late 1960s and early 1970s (Collins 1969, 1970, Mellars 1970, Bordes 1970, 1973, Binford 1973, Binford and Binford 1966). In the present context the most significant criticism is that of Mellars, who points out that there is no evidence that the groupings found represent "tool kits", and that even if this hypothesis is accepted, there is no way of knowing what range of activities, different or similar, they represent (Mellars 1970: 83). Gamble restates this by describing the functional categories as "educated guesses", and points out the further problem, that the location where the artifacts were "thrown away" might not be the same as that where they were used. (Gamble 1986: 13) These two difficulties make it very hard to accept the results of Binford's work, and in the light of the development of functional analysis directly based upon the physical traces on the tools, Binford's arguments may appear somewhat irrelevant. The significance of Binford's work lies more in the methodological and theoretical impetus it gave, rather than in the immediate value of his functional argument. The positions adopted by Binford and Bordes may have been extremes, but together they have ensured that both cultural and functional aspects of assemblages are considered in the interpretation of stone tools, and demonstrated how much a real method for examining stone tool function directly was needed.

Mellars:

Mellars' examination of industrial variability in the British Mesolithic (Mellars 1976), although perhaps not strictly a "functional" analysis, is obviously of relevance here, as two upland and one island Mesolithic site have been used as case studies (Smittons, Starr and Gleann Mor). His hypothesis will be examined more closely in the section on these sites, but essentially the intention was that his "suggestions will at least provide a series of explicit 'models' which can be systematically tested" (Mellars 1976: 375). The hypothesis is based upon an analysis of the size of settlement, its location, and the type of "essential tool" assemblage found. The model is grossly oversimplified as it does not take into account any chronological changes, or consider the re-use of sites. There are clearly similar problems with his concept of "essential" tools as there are with Binford's tool functions. In particular Myers (1987) has criticised Mellars' assumption that individual lithic pieces represent individual tools, rather than components of tools, as is the traditionally accepted case with microliths. The selection of these tool categories is however the result of the recorded evidence (Mellars 1976: 386). The use of "essential" tools allows comparison between assemblages despite the vast range of recording standards and typological methods used in the British Mesolithic. As such it represents a framework against which to test a functional analysis of the traces found on mesolithic tools.

Conclusion:

Functional analysis based upon wear traces is not the only method used to approach the function of stone tools. The use of ethnographic work has continued to be of great importance. The studies of Gould (Gould 1980), Hayden (1977) and White (1977) are just some of the recent attempts to study people who have only recently stopped using stone tools. While caution is always needed when using modern ethnographic data to assist in interpreting the past, much useful information can be gleaned from these studies. These studies are beyond the scope of the present study, but their importance should not be underestimated. Perhaps the single most important element of this type of work is the

"surprises" that come out of it, balancing our own preconceptions of tool use.

It can be seen from the above that the study of stone tool function has become a very wide-ranging area of research. A substantial quantity of information now exists on sites over a broad geographical and chronological spread. However, it must be stated that the problems of such functional studies are frequently overlooked, and that much of that information has been presented in a way that does not permit detailed re-analysis, or accurate comparison. These problem areas are the subject of the next section.

3: General Theory. The Nature of the Evidence.

The purpose of this section is to cover the nature of the evidence, the means of acquiring that evidence and some of the problems associated with it. Although much work has been done on functional analysis, it is still a relatively new study, and it is important to consider the basic principles upon which it is founded.

The Basic Principles of Functional Analysis:

Formation of Wear:

The basis for all current methods of functional analysis is that while tool shape and form may provide some information about function which may then be compared with the ethnographic record, more detailed and reliable information can be found by examining what happens to replica tools during experimental use and then comparing this with the state of archaeological pieces. Edge damage (scarring and rounding of the working edge of the tool), polish (a pattern of reflective smoothing on the tool surface) and striations (scratches in the tool or polish surfaces) can all appear as the result of tool use. The underlying assumption of all functional analysis is that the study of these features can be used to determine tool use.

The precise causes of the various forms of wear are understood to differing degrees. Methods and interpretations vary widely between analysts, with emphasis being placed on different elements of the 'wear traces'. The major variations in schools of thought are treated in the review section above.

Edge Damage:

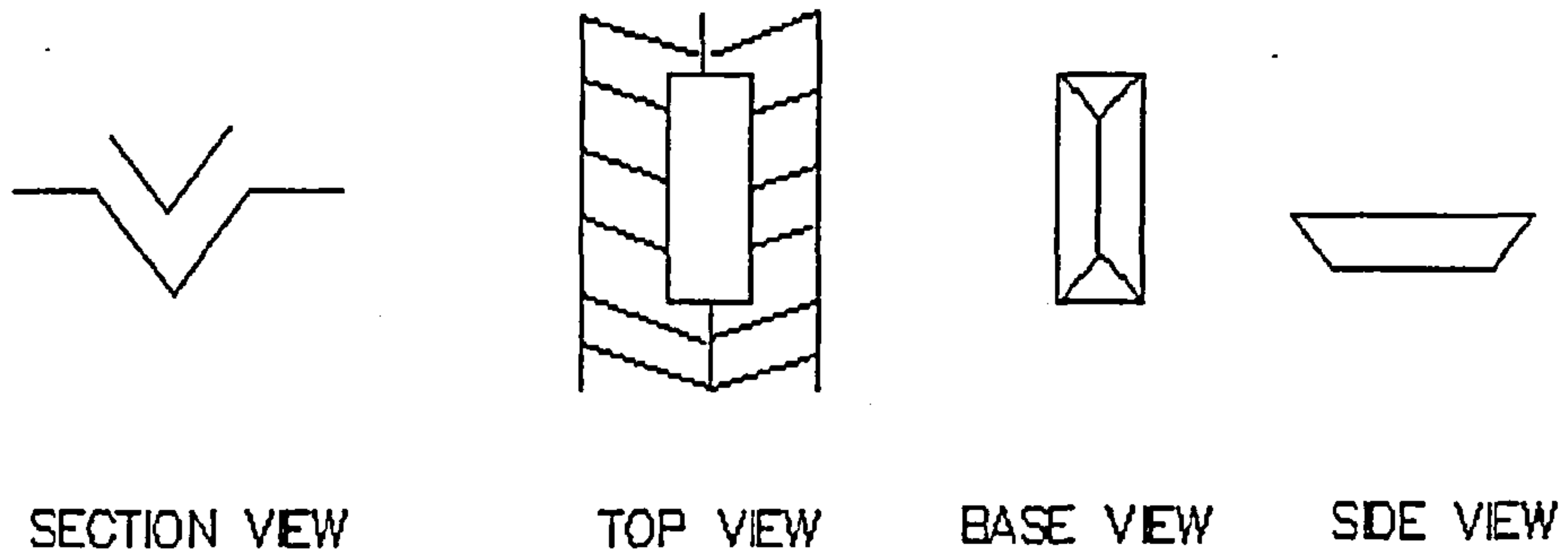
Edge damage (or, when definitely attributable to use, utilisation damage) is the most readily explained wear feature. The fracture patterns of brittle solids are fairly well understood (Hayden 1979), and similar interpretations to those given to explain knapping features can be used to explain edge damage. The principles that differentiate hard hammer, soft hammer and pressure flaking apply to the different types of edge damage that occur. Unfortunately, although these principles are well understood, edge damage is neither as predictable, nor as uniform, as the simple theory that correlates it directly with tool use. There are a number of variables that affect the development of edge damage.

The major variables of the mechanics of edge damage can be listed as follows:

- 1) Hardness of worked material
- 2) Direction of force
- 3) Amount of force applied
- 4) Combination of simple blows and pressure
- 5) Edge angle of tool
- 6) Degree of penetration
- 7) Nature of tool material
- 8) Differential hardness in working (caused by variation in worked material and inclusions, such as grit, fragments off tool)
- 9) Alteration during use of
 - a) direction of force
 - b) amount of force
 - c) edge angle of tool
 - d) degree of penetration
- 10) Errors and Misuse

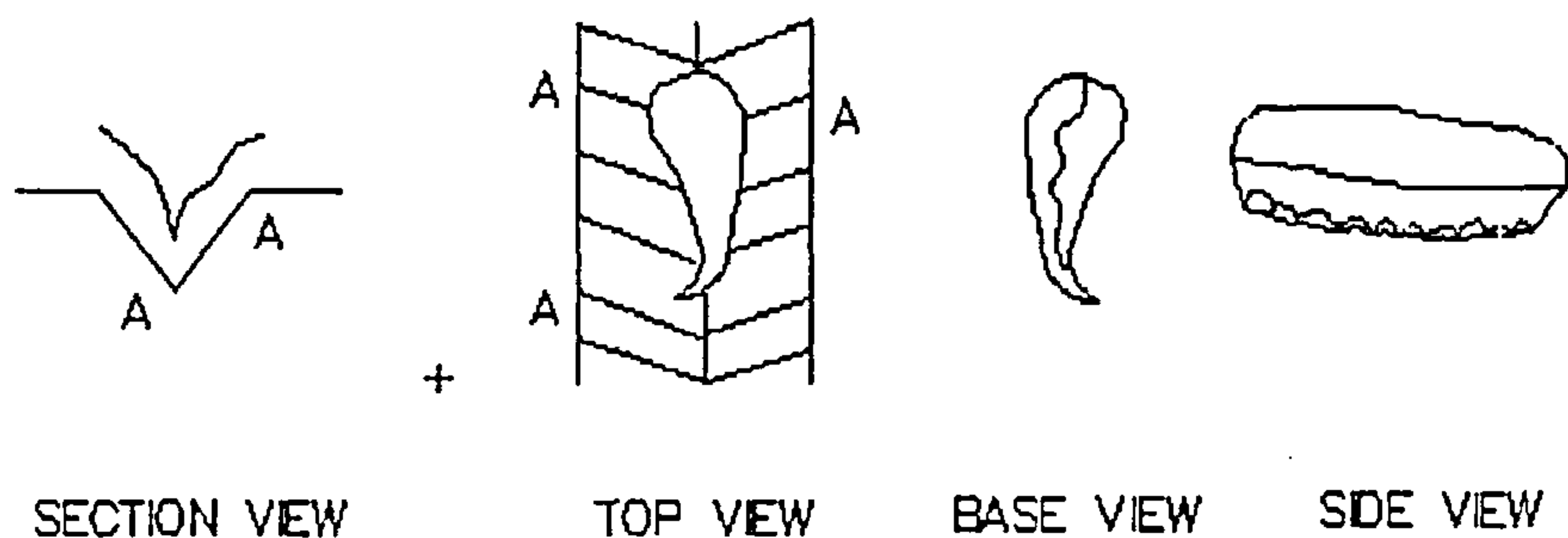
All of these variables are closely interrelated, but are, for the purpose of clarity, discussed as separately as possible. Simple, and grossly exaggerated, illustrations are given in figures 3.1 to 3.4. Where a simple parallel can be drawn with flint knapping this is mentioned by means of an example.

IDEALISED MODEL



regular shape allows uniformity and high predictability

EXAGGERATED "REAL" VIEW



A = areas of greatest pressure

extreme irregularity of edge caused by rippling, retouch and edge damage

Fig 3.1 model of sawing

Hardness of worked material:

The variable of worked material hardness can be equated to hammer type in knapping, hard materials being similar to hard hammers, and soft materials similar to soft hammers. This principle is at the core of the 'Low Power' method's differentiation between hard worked materials and soft worked materials. Various categories of hardness of worked material have been suggested, usually with three or four divisions, as in 'soft', 'medium' and 'hard' (Tringham *et al* 1974: 189),

further refined by Odell into 'soft', 'soft medium', 'hard medium', 'hard' (Odell 1980: 101).

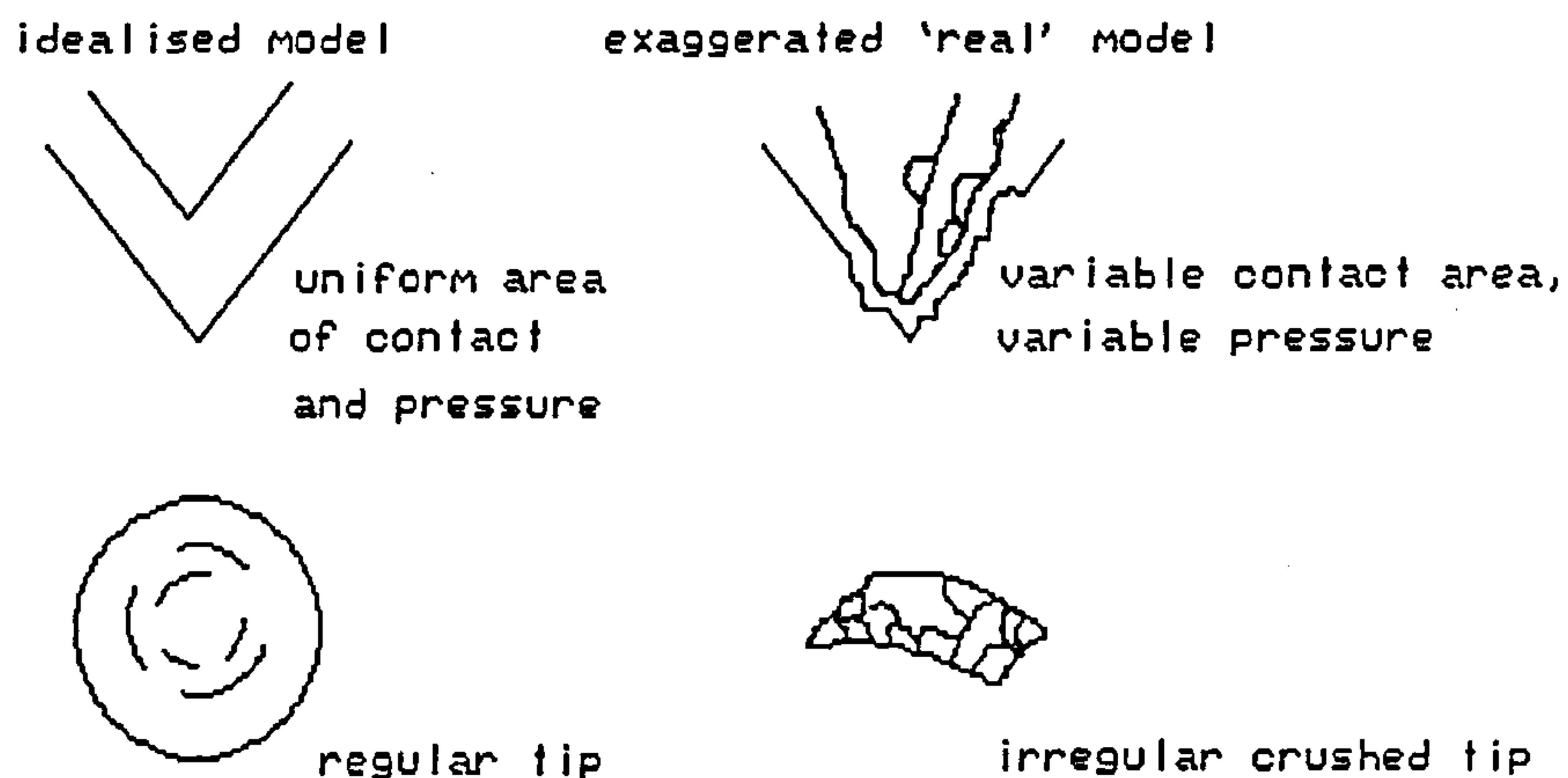


Fig 3.2 model of Drilling/Boring

Direction of force:

Direction of force is normally divided into two major groups: transverse actions (scraping, shaving, etc) and longitudinal actions (sawing). A number of tasks do not fit well into these categories, including boring and chopping. Related to knapping, the direction of force should dictate where flake removals occur. With transverse actions these should occur on the opposite face of the tool to the face being pressed against the worked material (the non-contact face). Longitudinal actions should produce a predominantly bifacial pattern of scarring (Odell 1980: 98). Odell maintains that further discrimination can be made:

"Pressure on the tool which favours one side over the other causes primarily unifacial wear. This is a fundamental distinction between **scraping** and cutting, though it was noticed... that cutting at an angle also produces damage primarily to one side." (Odell 1977: 300)

On a smaller scale, the precise angle between force and tool affects individual flakes.

Amount of force applied:

The amount of force applied during tool use affects the size and shape of flakes removed, whether this force is in the form of heavy blows with a chopper, or of increased pressure while scraping.

Combination of simple blows and pressure:

The way in which the force is applied influences the size and shape of flakes removed. This can easily be related to the various knapping techniques of direct percussion, indirect percussion and pressure flaking.

Edge angle of tool:

The edge angle of the tool can be compared with the striking platform of a core, or with the edge of a flake to be retouched. This 'platform' affects how easily flakes can be detached and how far they spread over the tool surface. As a result, the flake termination can also be affected. Consequently, variation in tool edge angle can (in conjunction with direction of force) cause variation in flake removal. As the edge varies in angle along the tool, so the removal may vary.

Degree of penetration:

The amount by which a tool penetrates the worked material can affect scarring. The pressure around the tool influences the direction in which the initial applied force can travel. Related to knapping, this can be seen as the equivalent of holding the core tightly in order to detach longer flakes or blades. Lack of pressure allows the applied force to escape more rapidly, producing shorter, wider flakes.

Nature of tool material:

The raw material of which the tool is made may cause variation in edge damage, in the same way that raw material influences knapping. The differences between raw materials are more significant in functional analysis than in knapping, as attention is on the minutiae of scar shapes.

Differential hardness in working:

The nature of most worked materials is that they are not uniform in hardness (different grain directions, densities in wood, presence of gristle, fat and bone in meat, variations in moisture content, etc, note Fig 3.3). These factors can be combined with prehistoric working conditions where varying amounts of extraneous matter (sand, grit, leaves, etc) will almost inevitably become involved in the process at hand, as anyone who has camped or had a barbecue on the beach will know. Flakes coming off the tool will add to this interference. All these features will, in quantities varying from moment to moment, affect the precise patterns of edge scarring.

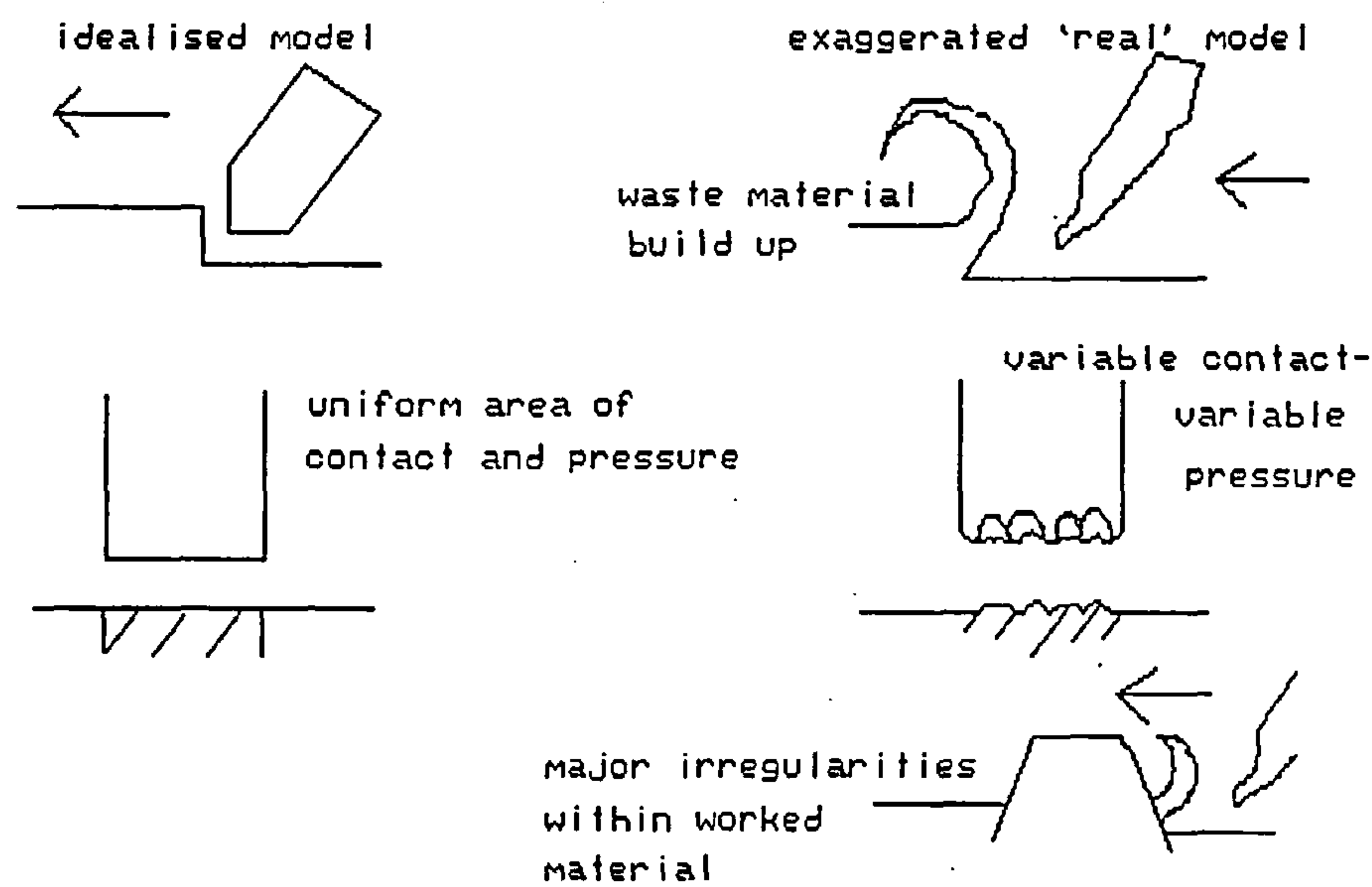


Fig 3.3 Model of Transverse Motion

Changes during use of tools:

This range of variables is closely related to the last one, and is a major stumbling block. Hand-used tools are not used like the latest robot-controlled tools. The angle and force of each stroke with a tool will vary, often minimally, but frequently greatly. This is not just the result of human inaccuracy, but dictated by the practical needs of the task in hand. As one works, the way in which the tool is used is modified to best suit the progress of the work. Tiredness, or a need for haste may also affect the force applied. Not only will the worker be deliberately altering the use of the tool, but, particularly where the edge is degrading, a chipped stone tool's own shape may be altering considerably during use. Depending upon the task in hand the tool may change edge angle without being abandoned (or re-sharpened). This may cause a further accommodation by the worker to his task, and will obviously mean a change in the edge angle variable. As work proceeds the degree of penetration may alter, either increasing due to successful use of the tool (as in boring), or decreasing due to increasing bluntness of the tool.

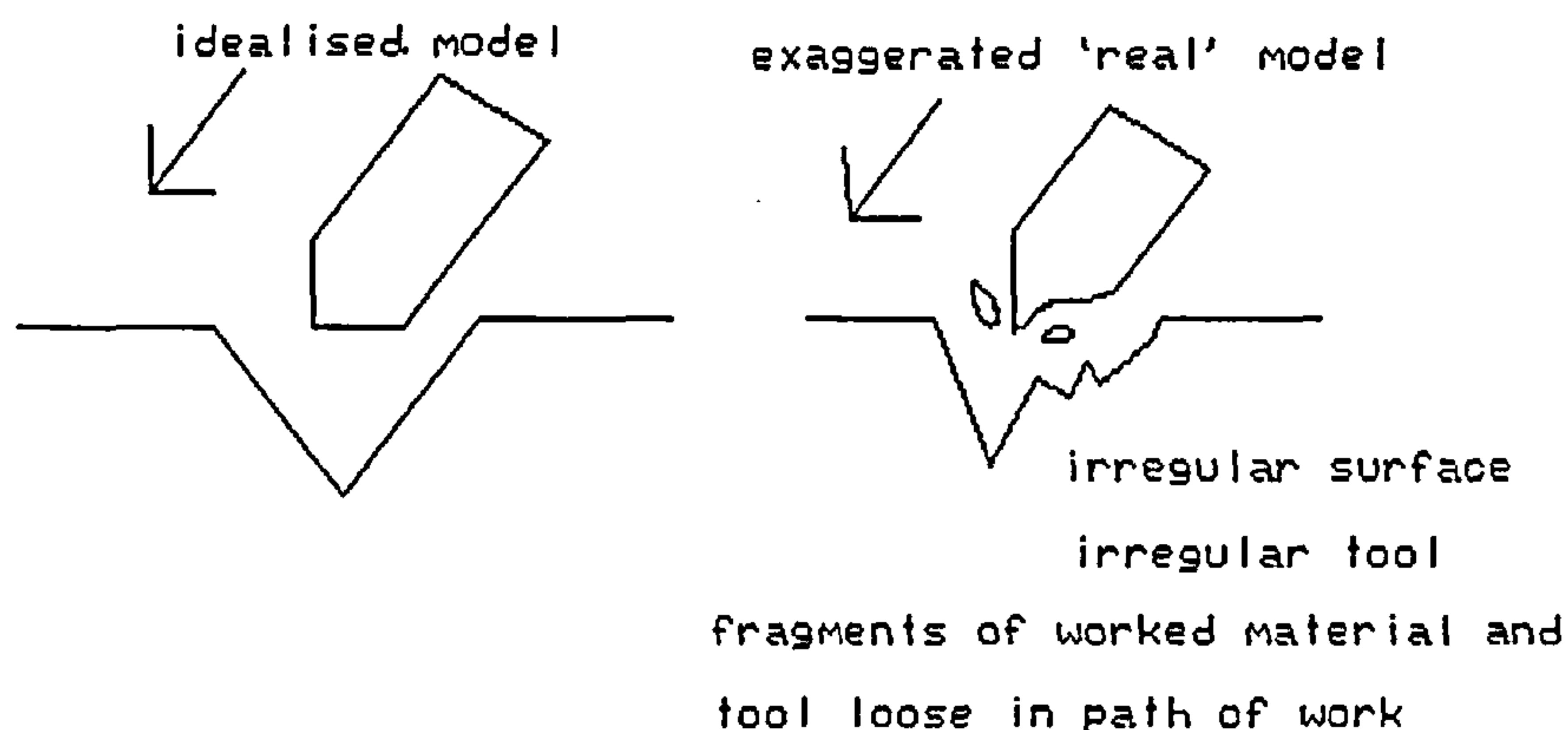


Fig 3.4 Model of Chopping

Errors and Misuse

In addition to the above reasons for variability of effects during tool use, errors may also occur which can influence wear patterns. Accidental slips with the tool (which can occur frequently) can often produce more

visible scars than the theoretical ideal working method. Particularly in sawing, the edge damage caused by the primary function produces flakes which can then go on to cause damage themselves, as the tool constantly pulls backwards and forwards over the flakes already detached. While some of the more extreme effects of these last problems tend to decrease with increased expertise of the tool user (also noted by Moss (1983b)), they remain present, and continue to produce some of the most evident wear. Similarly a tool designated for one task and used (or misused) for a very different task will almost certainly produce more wear than if the tool is used for its designed purpose. This must be seen as a warning to anyone who would seek to generalise from very clear traces that appear on only a few tools!

Conclusions

The features described above comprise the main variables effecting edge damage. It is possible to consider them in even further detail in terms of the mechanics of brittle solids (cf Hayden 1979) but such detail is not needed here. It is clear that edge damage is somewhat more complicated and difficult than one would wish. The detailed experiments and measurements of such features as 'spine-plane angle' (Tringham *et al* 1974: 179) that characterise the "Low-Power" method are the result of the attempt to quantify the numerous variables.

Striations:

Striations are features that are now fairly well understood. These scratches were seen as a very common feature in Semenov's pioneering work, but now, unfortunately, perceived to have been the result of the presence of Russian Loess soils acting as an abrasive (Moss 1983a) and they have not been found in similar quantities in West European work (Keller 1966, Tringham 1974, Vaughan 1985). They appear to be primarily the result of foreign particles involved in tool use, such as sand grains, or the result of small chips from the tool caused by edge damage, which have been dragged back over the tool. This dragging has occurred under pressure between the tool and the worked material, to produce linear patterns of tiny flake scars, only usually visible at SEM magnifications, and seen under optical microscopy as scratch marks on the tool or polish surface. (Fedje 1979, Knutson 1988)

It is important when discussing striations to be clear about exactly what is meant by this term. Vaughan, for example, refers to three different types of striation, 'deep striations', which are grooves in the flint surface; 'superficial striations', which are spots of linearly arranged polish; and 'directional features', which "constitute features that were an integral part of the surface of micropolishes" (Vaughan 1985: 24). Of these three he treats directional indicators as part of a polish pattern. In this paper, only the first of his classes is considered as striations, whether they score through an unaltered or polished tool surface. His superficial striations are described as linear polish. The directional indicators are not considered as striations at all, but are treated in the same way as Vaughan actually treats them, as part of the polish pattern.

One of the most detailed papers on striations is that by Mansur (1982) where the mechanisms of striation formation are discussed in depth. From this work she developed a detailed morphological classification of striations. Unfortunately, the rarity of striations in West European archaeological material means that this wealth of detail has little

practical value. They do however remain, when present, a useful directional indicator.

Polish:

Polish, despite being seen by some as the most diagnostic of all use traces, is the least well understood phenomenon. It is also perhaps the least well-defined feature of use-wear. Vaughan describes it as:

"an altered flint surface which reflects light and which cannot be removed by cleaning with acids, bases and solvents" (Vaughan 1985: viii).

Even this broad definition may not be entirely accurate as it has been noted that polishes may be altered by the use of caustic cleaning agents (Plisson 1983, Unger-Hamilton 1985). Commonly no attempt is made to define polish as a singular phenomenon, but rather to describe each 'type' of polish individually. The most detailed descriptions of polish tend to be associated with an explanation of the cause of the polishing, as in Diamond:

"Polish topography is a wear pattern composed of long and very fine scratches on relatively shiny and worn surfaces; the scratches do not penetrate the worn surface to any great depth and are not visible to the unaided eye..." (Diamond 1979: 159).

This definition of polish is associated with a theory that suggests that polish topography is the result of:

"(1) very mild and mild abrasive wear, (2) fatigue breakage wear, and (3) surface fatigue wear processes, and it may be a more complex phenomenon than was first believed." (Diamond 1979: 165)

Of course, such a relationship between cause and effect means that other workers whose own interpretation of what a polish looks like, and who

see the formation of polish differently, will produce different polish definitions.

There are now a number of theories to account for its formation. Curwen believed that polish production was dependent on the presence of organic silica (Curwen 1930). This explanation has been elaborated upon to try to explain the polishes which are so common on sickle blades. It has been argued by Morris that flint does not melt until a temperature of 1602°C , and that although flint may reach very high temperatures during work, these temperatures do not last for a sufficient length of time to alter the flint (Morris 1979). However he believes that flint may reach a temperature of 600°C during work, and that 573°C is a crucial temperature, as at this point there is a low-high inversion when the flint changes volume and molecular structure. Working with the flint tool will cause rapid heating and cooling across this temperature boundary, which causes weakening by microscopic fractures. This opens the quartz crystals to physical and chemical attack, allowing polish formation. This theory is only put forward to explain polishes produced in bone working, bone apatite being one of the few worked materials that could withstand this temperature. Moss suggests that the mineral content of some plants could also withstand this temperature, plant opal possibly changing internal structure while keeping its general shape (Moss 1983a). Against this Levi Sala (1988) suggests that her experimental work shows no connection between heat and polish.

Anderson has put forward another model for polish formation (1980), using a combination of factors. These include friction-induced heat, acidity, abrasive particles, phytoliths and crystalline materials combining with water to allow silica dissolution. The presence of about 115 parts per million silica to water can produce the formation of a silica gel. The deposition of amorphous silica onto the tool surface allows the incorporation of the plant phytoliths into that surface as it is created. Her results and theoretical model have not been universally accepted, Meeks *et al* (1982) have argued that there is no evidence for a deposited silica layer, and argue against the incorporation of phytoliths into such a layer. Another problem has been that other workers have failed to find

phytoliths incorporated into 'sickle' polishes. (Masson *et al* 1981, Unger-Hamilton 1985)

Much of Anderson-Gerfaud's work has been concerned with the polish found on sickle blades. She has made use of the high-power magnification of the Scanning Electron Microscope (SEM), and has published a number of papers identifying phytoliths embedded in the polish. (Anderson 1980, Anderson-Gerfaud 1983) The phytoliths (silica skeletons from certain plant cells) were identified at magnifications of around 1500x. These were used to examine the types of plant cut.

In the course of the current project a small sample of Natufian sickle blades from Mt Carmel, all with macroscopically visible gloss, were examined at similar magnifications and no evidence of phytoliths remaining was found. R. Unger-Hamilton suggests that great care has to be taken in the identification of residues. In her own SEM study she has found features that resemble Anderson's 'phytoliths', but these have occurred on flints used only to rub other flints (Unger-Hamilton 1985: 63). The explanation for these features that she presents is that they are items incorporated during the formation of the flint. This hypothesis is supported by Masson, who suggests that many features interpreted as use-wear traces may in fact be of geological origin (Masson *et al* 1981).

That problem aside, the expensive nature of this type of SEM technique dictates that it can only be justified in particular circumstances. SEM's are not readily available to all, and most are very limited in chamber size, requiring breaking of tools, or the manufacture of casts. Breakage is obviously a problem with much archaeological material, while casting is time consuming, can be expensive depending on the technique, and can lead to loss of resolution, particularly when such high magnifications are needed.

Apparently supporting Anderson's work was the finding of hide cell impressions in the surface of polish diagnosed as 'hide polish' by Mansur-Franchome (1983). However hide could not have stood up to the temperatures required by Morris's model, nor is there sufficient silica in hide to cause the silica deposition put forward by P. Anderson. The two other models for polish formation, one based mostly on friction (Meeks *et al* 1982) and the argument that chemical action is far more

important than normally considered (Del Bene 1979, Masson 1982, Rosenfeld 1965) do not help to explain the presence of such casts.

Bettison has also been concerned with the examination of 'sickle gloss' using the SEM. She comes to a different conclusion to Anderson. She suggests that there are two different forms of sickle gloss, only distinguishable with an SEM. These are the result of a) attrition; caused by friction from working dry plants, and b) addition; caused by the deposition of plant silica when working green plants (Bettison 1985: 26). Her work suggests that this method has potential for examining the seasonality of harvesting. However, in the context of Anderson-Gerfaud and Unger-Hamilton's conclusions, her work suggests that there are still further problems in the interpretation of SEM images in the light of our current understanding of polish development. Although the SEM allows us to examine the tool surfaces at extremely high magnifications, it does not of itself help our understanding or interpretation.

Energy dispersal analysis, EDAX, is a technique which has been used with some success both by Van Gjin and Anderson-Gerfaud. There are problems with it, chiefly the fact that it loses accuracy with elements of low atomic number, and it is therefore poor with the crucial organic residues that functional analysts are interested in. However, when used sensibly it can provide useful supplementary information.

EDAX analysis has demonstrated that the visually perceived 'exfoliating' layer on a tool (often seen as proof of the presence of a depositional layer) was in fact the layer of gold that the item had been coated with for SEM examination (Anderson-Gerfaud 1986). Another useful application was to suggest that an experimentally produced 'fish polish' was depositional, and thereby encourage further useful work (see below) (Van Gjin 1986).

At present therefore the exact cause of polish formation remains unclear. It is possible that a number of different processes may be involved, in part depending on the material worked. How convincing this

argument is depends very much on how different the polishes produced by working different materials are perceived to be. Unfortunately, one of the problems with polish identification is the lack of a clear understanding of what has caused a particular polish to form.

Several workers (Mansur-Franchome 1983, Unger-Hamilton 1983) have reported that the appearance of polish can vary with the amount of water present. The number of other variables that may be affecting polish formation are many. R. Unger-Hamilton has listed some variables that may affect the development of polish on sickle blades:

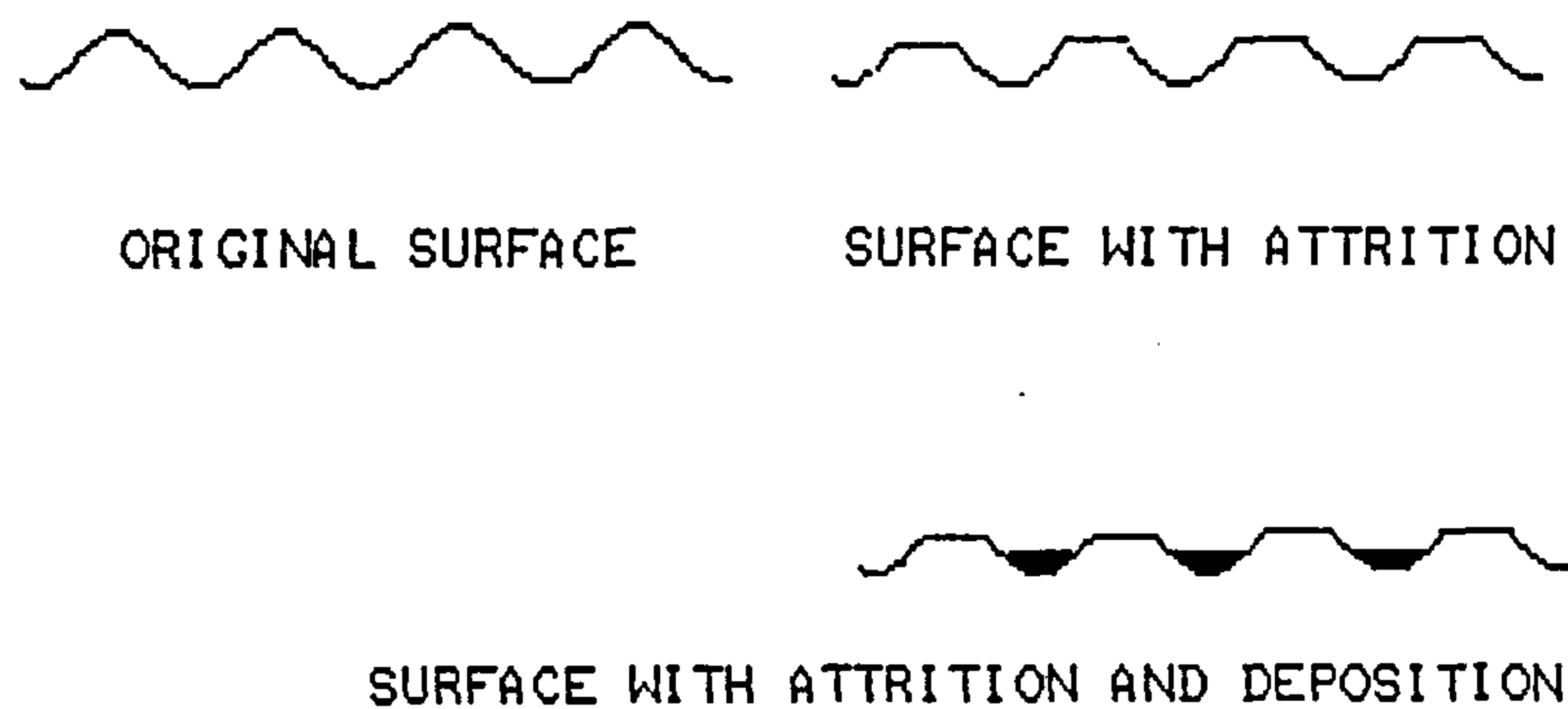
1. The plant species
2. the water content of the plant
3. the point at which the stem is cut
4. the time of year of harvest
5. the number of stems cut with one movement
6. the source of flint
7. the force applied by different workers
8. the resistance or hardness of the stem

In addition to these she lists a number of other variables which she did not test at all but kept reasonably constant, "the direction of the cutting movements; the dimensions, shape and angle of the edge of the blade; the temperature, humidity and windforce during the experimental work." Other variables were not controlled at all: plant opal content, mineral content and pH of the soil. (Unger-Hamilton 1983: 244) This appreciation of the number of potential influencing factors is unusual in functional studies, and is applied to only one aspect of polish formation, sickle blades. Most studies do not contemplate this array of variables, although they are concerned with a far greater variation in tools and tasks. Of course, while the effects of the different variables may be observed, this increased complexity may not assist simple polish 'type' analysis. The implication of such work is that polishes vary enormously, and not only as the result of the specific material worked.

Dumont puts forward a very useful theory to explain why use on different materials should produce different polishes. He argues for a complex inter-relationship between a number of factors, based upon four necessary conditions for polish development: contact, relative motion, pressure and time (Dumont 1985: 4). The most important part of his theory concerns the plasticity (deformability) of a worked material and

empirical observation of variation in polish formation during tool use. One more problem occurs here. Polishes, already known to be difficult to describe in general, would appear to be hard to describe even in specific cases. Kamminga (Kamminga 1979) and Witthoft (Witthoft 1967) perceive differences in polish topography. Meeks (Meeks *et al* 1982: 337) does not believe that Anderson (Anderson 1980: 184) is really observing a build up of an additive layer on the tool she describes and photographs. Moss (Moss 1983a: 83-105) summarises her own results with those of other workers, notably Keeley, Anderson and Vaughan. Although there is a general agreement between them, many details of description are different, as are categories of worked material. This point will be covered, along with the use of terms such as 'greasy' and 'melting snowbank', below. It is sufficient here to point out that the description of polishes is difficult, and that interpretations of the same features may not be the same, indicating a need for some means of objective standardisation, if at all possible.

The model of polish formation accepted as an adequate working hypothesis in this project is based upon that proposed by Unger-Hamilton (Unger-Hamilton 1985), where polish is seen as being primarily the result of attrition, with the possibility of a build-up of a thin layer of amorphous silica in certain cases. No direct testing of the hypothesis was conducted, but its use allowed better sense to be made of the observed data. (Fig 3.6) The variability of the attrition was seen as related to Dumont's point pressure theory. This hypothesis permits the interpretation of wear traces, both macro and micro, to be based upon their location on the tool, and on the microtopography of the tool. For example a hard material will have high point pressure, producing a polish rapidly, but this polish will not invade the lower parts of the microtopography. A soft material will not produce a polish so rapidly, and because of better penetration into the microtopography, that polish will be more evenly distributed over the tool surface. Of course variations in tool texture, lubrication, and the possible build-up of amorphous silica will tend to complicate this.



Model of Polish formation

Fig 3.6

This model seems to be in broad agreement with Levi Sala's work on polish development, which suggests that there is no polish that is "exclusively produced by one material alone" (Levi Sala 1988: 95), but that hard materials, or soft materials with a hard backing will initially polish on the high points of the microtopography, and will then fill/link up, the rate dependent on the amount of liquid present. Soft materials, or hard materials with a soft abrasive, will develop evenly on the high and low parts of the microtopography. This is supported by her controlled experimental work, and by the experimental programme conducted here. It is also grossly explicable in terms of Dumont's model.

Differences in tool material:

A further variable affects polish formation (as well as edge damage). This is the variability in tool material. Vaughan (1985) mentions that he studied three different varieties of flint, distinguished on a relative basis by grain size, and visibly different on a macroscopic scale. He notes that the coarser the grain size, the longer it takes for a given polish to develop, establishing a "sliding scale or continuum of patterns of

distinctive polishes" (Vaughan 1985: 28). Holmes (1987) notes that the differences between Egyptian chert from Eocene limestone and British Upper Cretaceous chalk flint were not apparent to the naked eye, nor at low magnifications, but at 400x they appeared quite different. His general conclusion is the same as Vaughan's, that on the coarser Egyptian chert, polish formed more slowly. S.Beyries has conducted a test of eight different raw materials and has also found that polish traces vary between rock types (Beyries 1982). Bradley and Clayton (Bradley and Clayton 1987) have studied the reasons for this, although in the context of the heating of flint (deliberately or naturally) and have come to the following conclusion:

"The recrystallisation (caused by heating) also results in a much higher proportion of well-crystallised quartz in the structure and since this is more resistant to mechanical and chemical attack it is anticipated that recrystallised flint will show a greater resistance to microwear polish formation. Conversely, since it is easier to knap, it may exhibit a greater susceptibility to microfracturing than unaltered flint and be more susceptible to chipping." (Bradley and Clayton 1987: 83)

This pattern of variability is also found in the materials of the present study, which ranged from Scottish chert, which has undergone significant recrystallisation naturally as a result of deep bedding processes, and the Cypriot chert, which includes material entirely made up of Opal-CT (disordered cristobalite) which has not yet matured into quartzose flint. It appears that the explanation given above is not the only cause of variation in polish development here. The coarser materials have, as a result of their grain size, a greater elevation of microtopography. This has a direct bearing on polish formation, limiting the area in contact with worked material and tending to produce 'reticulated' or 'poorly linked' polish patterns more frequently than a smooth fine grained flint surface. Polishes produced by the same effect on different materials can appear different in pattern and in degree of development. (Fig 3.7)

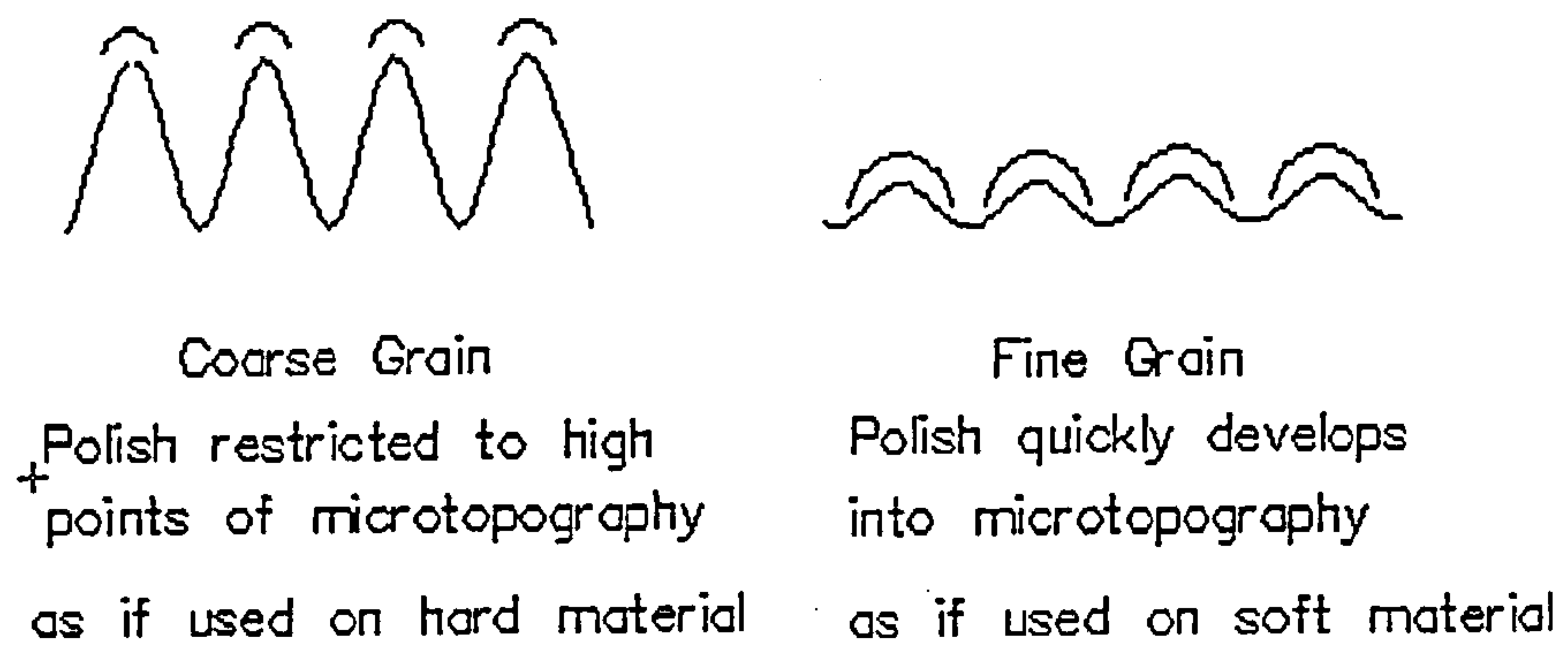


Fig 3.7 Variation of Contact Area on different Tool Materials

Experimentation:

It was stated at the start of this chapter that the basic principle of functional analysis was to conduct replicative experiments to examine what happens to a tool under known conditions. Details of the experimental procedure used here will be discussed in the section on experiments.

Much has already been written on the nature of experimental programmes, their authenticity, their purposes (from tool efficiency studies to replication of wear traces) and their failures (Ascher 1961, Sonnenfeld 1962, Semenov 1964, Keller 1966, Keeley 1974, Odell 1975, Frison 1976, Newcomer 1980, Moss and Newcomer 1981, Cook and Dumont 1987, and others). Vaughan has collated some of the experimental data (Vaughan 1985), and in fig 3.8 some detail has been added on more recently conducted programmes. Cook and Dumont (1987) also provide a summary of experimental programmes.

Experimental studies are an area that has suffered particularly from the flaws of limited scope and poor standards. This means that despite the numerous programmes conducted, few can be studied in depth. Many have been very small studies (often for specific purposes, like Sonnenfeld on stone hoes (1962)), and many have not been up to the standards now required. Odell's experiments are an example of this, as in this case the experimental sample did not match the archaeological material as it contained no retouched pieces. Dumont, who based his work primarily on the reference collection made by Keeley out of English chalk flint, only conducted a very small set of experiments with the Antrim coast flint that his Mount Sandel material was made of. Although he satisfied *himself* that polishes were identical on the two materials, the set of experiments are not reported in any detail. The relevance of the experimental sample to the archaeological sample, with particular regard to stone raw material and to tool morphology, is seen as being of prime importance (Moss and Newcomer 1981). Care must of course be taken with the use of experimental data. Odell presents a circular argument when he states:

"That this form of wear has never been successfully duplicated experimentally is no surprise, because it takes an exceptional combination of factors to produce the wear and still leave the flint intact."
(Referring to two projectile points) (Odell 1977: 609)

It is essential to remember that it is impossible to cover all the possibilities of tool use (especially those of an accidental or opportunistic nature) in replicative experiments and that even taking all the experimental samples together our total experimental base for each type of tool use remains small. If Moss's sample (1983) is added to Vaughan's figures, the total number of pieces used to work stone only comes to 26. Although there are 232 pieces used for wood working (one of the most intensively investigated contact materials), these figures cover all the experimentally tried tasks. Vaughan explained that the greater variability of edge damage in his study compared to Odell's, was at least in part due to increased sample size (Vaughan 1985). From this it can be suggested that some of the problems of 'High Power'

functionalists are related to the definition of clear polish 'types' before an adequate experimental sample has been made. The development of models of polish differentiation, with an increasing overlap between polish 'types', is perhaps a reflection of this. Experimental studies suggest patterns and parameters, but do not provide an easy one-to-one comparison, a point that Odell makes:

"There is as yet no one-to-one correspondence between a tool's function and the traces of wear on it". (Odell 1977: 473)

While Odell was referring to a functional analysis based upon edge damage, it seems that this statement is equally applicable to polish-based identifications. Cook and Dumont also stress this point:

"the experimentally determined 'cause' can be no more than suggestive of the archaeological 'cause' and should not be used as an explicit explanation of the observed archaeological 'effect'. The temptation to equate known cause and known effect at the experimental level to the unknown cause and observed effect on artefacts is very strong, but in the absence of additional, independent information regarding the nature of the archaeological 'cause', any such correlation is potentially misleading." (Cook and Dumont 1987: 55)

In the present state of our understanding of polish formation the data provided by experimentation can only serve as a "guide for ... interpretation" (Cook and Dumont: 55). Keeley's perception of a correlation between polishes and worked material may well have been premature, a point that will be taken up in chapter 5, where the purpose of functional analysis and the interpretation of data will be discussed.

EXPERIMENTAL PROGRAMMES

Experimenter	Total	Stone	Bone	Antler	Wood	Hide	Fish	Butcher	Plant	Missile	Shell	Pot	Misc	NUW
Vaughan (1985)	249	2	18	18	50	35		20	30				33	24
Tringham et al (1974)	91		12	8	36	8	4	5	3					15
Odell (1977, 1978, 1980)	71		8		13		2	9	11	30				
Keeley (1980)	127		32	10	56	18		11	2					
Anderson-Gerfaud (1981)	131	4	16	31	36	11		15	4					8
Moss (1983)	314	20	31	48	39	38	4	17	12	55	4		14	
Unger-Hamilton (1985)	438	41	55	25	56	20	5	11	187		12	18	5	20
Finlayson.	408	18	44	49	75	64	4	33	25	15	8	5	3	67
Total	1827	83	214	187	361	194	19	121	274	100	24	23	55	134

04

Fig 3.8

'Low Power' versus 'High Power':

There has been considerable debate over whether the 'High Power' (HP) or the 'Low Power' (LP) approach to functional analysis should be used. (Note that the much higher magnifications available with the SEM are not part of the HP method.) The LP method is claimed to have advantages in speed, and in the availability and cheapness of equipment, while the 'High Power' method is claimed to have the advantages of greater accuracy and increased information. Many workers consider that the validity of the HP method was demonstrated by the first blind test undertaken by Keeley and Newcomer, and it has consequently become the most commonly used method of functional analysis. In addition the end users of functional analysis (especially project directors, who are frequently responsible for the initiation of a functional study and the publication of the results), have come to expect results of the kind that the HP method purports to give. As the Keeley-Newcomer blind test was crucial to this expectation, it is essential to discuss that test and others that have followed. The volume of literature on blind tests now available necessitates that they be treated in a separate chapter. (See below, Chapter 4)

The different magnifications used by the two methods reflect a different emphasis on the evidence used. The LP method, having found that striations are not as common as Semenov reported (1964), has concentrated on the occurrence of microflaking edge damage (Tringham *et al* 1974). The HP method, following Keeley's work, has concentrated on the description of polishes. It must be stressed that in HP studies polish identification is not seen as an item to be used in isolation, but to be combined with the study of other features and variables such as tool morphology. Keeley, often regarded as using solely polish identification, points out that:

"It is clear that all ranges of magnification, from what can be seen with the naked eye to very high optical magnifications, must be employed in the study of implement function." (Keeley 1980 82)

The HP method does however tend to emphasise polish more than any other feature. The two approaches are not simply two different "means of skinning cats" (Odell 1980: 88). The differences are much more fundamental to functional analysis.

For the purposes of this section aspects of equipment, expense and speed, although important in themselves, will be left aside. The basic nature of the evidence has been discussed above. Here a more detailed consideration of the primary evidence of each method, edge damage and polish, will be presented.

The Presence of Use-Wear Data:

An important reason for using the polish identification HP method is not just the hope of more detail and information, but also that many workers now believe that polish is more reliable as an indicator, and more likely to be present than other traces such as edge damage or striations (Moss 1983a, Vaughan 1981). Vaughan points out that the presence of edge damage is variable, 16% of observations from transverse actions and 18% from longitudinal actions showed no scarring, and with regard to edge row scarring, (small scars along the proximal ends of larger scars), only 27% of observations from transverse actions and 17% of those from longitudinal actions "exhibited a scarring edge row".

Another factor influencing the presence of edge damage is the relationship between edge angle and hardness of worked material. Odell notes that tools with high edge angles may not show any edge damage after use on soft materials (Odell 1977). Vaughan's study supports this observation; he found that 6% of observations on tools used on hard materials showed no evidence of scarring, compared to 39% of observations on tools used on soft materials (Vaughan 1981: 114).

Moss also notes the frequent lack of edge damage and the difficulty of distinguishing utilisation edge damage from naturally caused edge damage (Moss 1983a) and states that

"edge damage was treated with a great deal of suspicion... edge damage has nearly the same frequency on unused pieces as on used ones. ... Sometimes...edge damage indicated that someone had attempted to use a curved edge but had abandoned the tool after a brief use, probably because it was inefficient." (Moss 1983b: 79)

In contrast to the apparent absence of edge damage in many cases, polish was found to be more consistent in its occurrence. Out of 187 observations of transverse actions, only 4 (2%) had no polish, out of 162 observations of longitudinal actions 8 (5%) had no polish, polish occurring even when no edge damage was present (Vaughan 1985: 149). Odell's initial response to Keeley that edge damage is the first wear feature to occur (Odell 1975) and his statement that

"Scarring usually occurs whenever a piece of flint is utilised, and generally in the absence of the other three" (polish, abrasion and striation) (Odell 1977: 584)

is at variance with these findings and may result from his failure to use high magnifications. Three things must be noted here. The first is that the tool raw materials were different in the two studies. The second, possibly explained by the first, is that the clear-cut model for which Vaughan argues is not supported by the data produced in the present study. The third point is that the polishes observed were not necessarily, in Vaughan's own terms, diagnostic.

Odell's work led him to suspect that polish was mainly associated with hafting (Odell 1977), but this supposition is at least partially based on his observation that polish is often unassociated with other forms of wear (Odell 1977). As it is now generally accepted that some sort of polish may develop before edge damage during use, this conclusion must be regarded as suspect.

The usefulness and reliability of the evidence:

Keeley (1980) notes that 'utilisation damage' is very sensitive to a number of variables other than worked material (edge angle, depth of

penetration) and that it can "too rarely be distinguished from the smaller components of retouch scar patterns". Consequently he believes that edge damage can only serve, in some instances, as a "useful check on an interpretation already based upon the microwear traces" and to provide some supplementary information. (Keeley 1980: 83)

Vaughan's examination of edge damage, and his conclusions again suggest that edge damage is an unreliable indicator of use. In contrast to the expectation that longitudinal actions should produce bifacial damage, he found that 17% of his observations produced unifacial scarring. He also found that transverse actions, which were expected to produce unifacial scarring on the surface away from the contact edge, produced 46% bifacial scarring, or scarring on the wrong (ie the contact) surface. In addition, the distribution of scarring along an edge did not conform well with the expected patterns. Examination of the edge row scarring also failed to match the expected patterns. Analysis of distal terminations, proximal cross-sections and scar sizes all showed degrees of unpredictability. He concluded that although there are trends in the pattern of scarring, they are neither as clear nor as simple as previously suggested (Odell 1977, Odell and Odell-Vereecken 1980, Tringham *et al* 1974). Vaughan's study is based on a detailed analysis of a large experimental sample (249 experiments). This suggests that the range of variation in edge damage that he observes may not have appeared in the smaller samples studied in the LP projects. (Vaughan 1985: 20-22)

Since Keeley first developed the use of polish as a diagnostic indicator of worked material, the model of how much different polish 'types' vary has changed. Keeley believed that despite some areas of confusion (meat with fresh, wet hide, wood with soaked antler, sawing bone and antler (Keeley 1980: 83)) polishes were fairly discrete entities. (Fig 3.9a) Vaughan identified three stages of polish development: 1) an initial 'generic weak polish' which developed after minimal contact with the worked material; 2) a 'smooth-pitted polish', an intermediate stage of short duration; 3) a diagnostic well-developed stage. His third stage is considered to be "usually diagnostic...because there are certain zones of overlap between various use-wear polishes". (Vaughan 1985 46) (Fig 3.9b) Grace has suggested that there is in fact a continuum of polish

development with duration of use being an important variable, and that any worked material

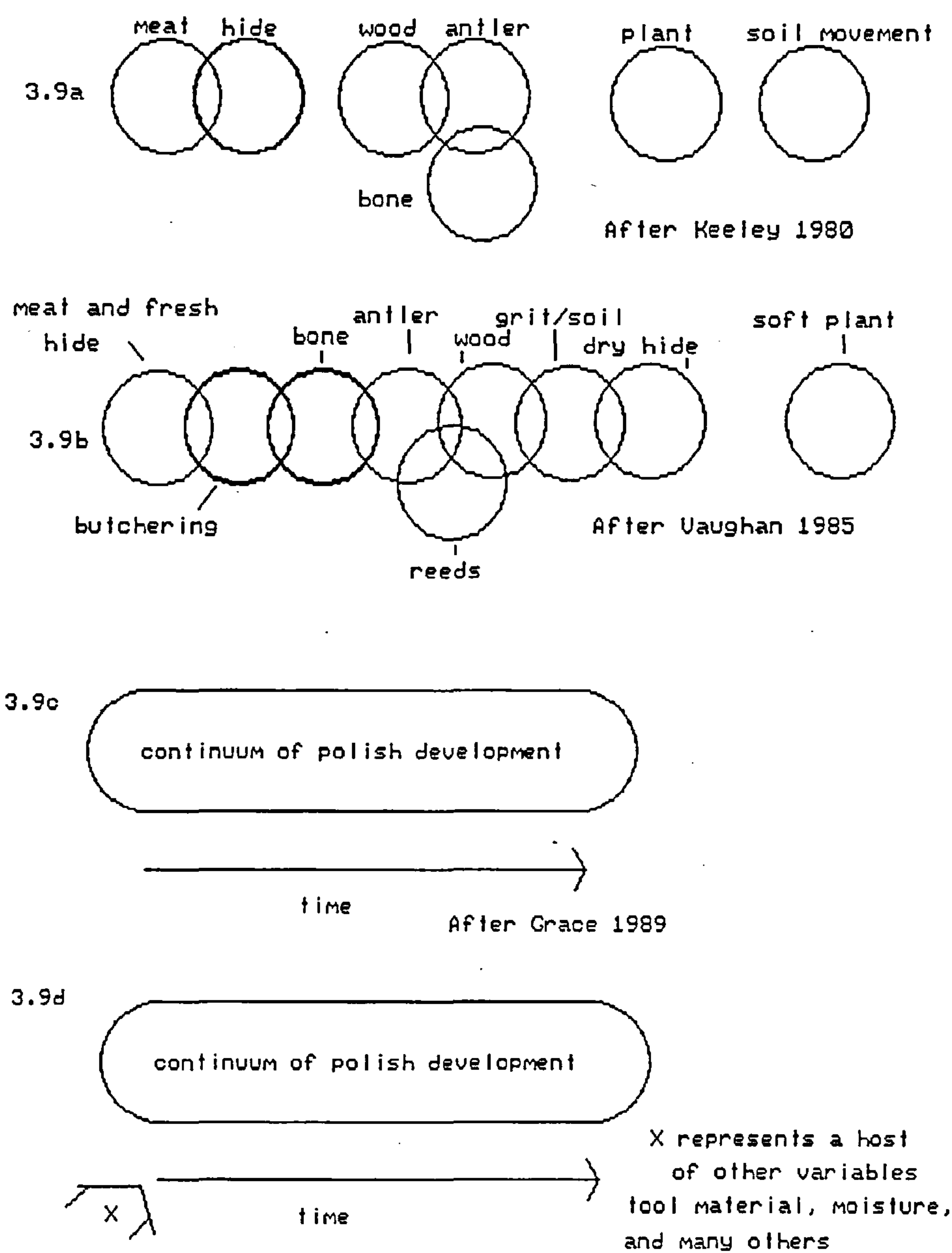


Fig 3.9 Polish: Discrete or Continuous?

may produce any form of polish depending on the length of time for which the tool has been used. (Grace 1989) (Fig 3.9c)

A further difficulty is presented by the textural variation of the tool material, and also by all the numerous other variables that may affect polish formation. (Fig 3.9d)

An additional problem associated with both edge damage and polish is that of non-use-wear (NUW). The presence of edge damage caused by natural factors or accidental droppage is a well-known phenomenon. It has been argued by the adherents of the LP method that accidental damage is relatively easy to distinguish, since it tends to have a random distribution (Tringham *et al* 1974). In contrast with this there is now a body of experimental work that suggests that non-use damage may appear non-random, and can confuse the analyst (Flenniken and Haggarty 1972, Moss 1983a, Vaughan 1985). This is not surprising, given that the essential mechanics of flake removal are the same in many circumstances. A further difficulty lies in the identification of edge damage on a retouched edge. Tringham admits that the distinction between retouch and damage "has been the source of much confusion" (Tringham *et al* 1974: 181). The recognition of use damage superimposed on retouch is even more problematic. Odell admits that although he concentrated on the retouched pieces from Burgummeer,

"Only a very few pieces from the total [experimental] sample have been subjected to secondary retouch after being hit off the parent core." (Odell 1977: 646)

While the advocates of polish identification have pointed out these problems with edge damage, there has been a tendency to assume that polish does not suffer from the same problems.

"Most natural processes, then, leave traces which are unlikely to cause much confusion for the microwear analyst, once he is familiar with them and with true microwear features, and provided he studies them at high enough magnifications. However, it seems clear that reliance on low magnifications and on edge damage alone will often not allow the analyst to distinguish between damage caused by natural processes and that resulting from human use." (Keeley 1980: 34)

This sweeping statement was made on the evidence of traces found on archaeological objects known to have suffered from soil movement and on four pieces subjected to trampling. Arguing from the evidence on an archaeological sample is somewhat circular and the experimental sample is clearly inadequate. More recently, work has been conducted which suggests that post-depositional effects can seriously affect tools and the

use-wear traces on them (Plisson 1983; Plisson and Mauger 1984; Vaughan 1985). Levi Sala's work on post-depositional effects is a clear warning to functional analysts to be careful in their approach to polish identification (Sala 1987). The experiments conducted during the course of this study (see chapter 7) further stress the problems.

A typical problem in polish identification can be seen in Van Gjin's (1986) work. She conducted a set of experiments on fish processing, since it was known that fish played an important role in the economy of the site under analysis (the Vlaardingen culture site of Hekelingen III, Holland).

From the experiments with fish three distinct types of polish were recorded. Of the two most diagnostic of fish working, one dissolved completely in a 10% HCl solution, and the other formed only rarely, when in contact with hard scales. The third type of polish, frequently present, would normally be identified as 'bone polish' (Van Gjin 1986: 17).

When the archaeological material was examined, the presence of 'fish polish' "could not be demonstrated conclusively on any of the archaeological implements examined." (Van Gjin 1986: 18). Four possible explanations for this absence were noted: 1) the fish were not cleaned; 2) the tools used were not made of flint; 3) the fish were cleaned elsewhere; 4) secondary natural modifications caused the wear to disappear. Explanation (1) was considered unlikely, and as the preservation of bone and wood on the site was excellent, (2) was also considered unlikely. All the flint was imported into the site, and in general the functional analysis suggested that the tools had been intensively utilised, and therefore curated. In addition there was a fish trap in the middle of the site, making explanation (3) unlikely. The fourth possibility had to be examined. Following an EDAX (see above) analysis it appeared that polish 1 was depositional. It was discovered

that it dissolved in a solution with a pH of 5.5, indeed it dissolved in the local clay! (Van Gjin 1986: 21)

This discovery led Van Gjin to examine other 'animal polishes'. Her work suggests that polish caused by working soft animal materials dissolves in medium acid soils. EDAX analysis supported her work by indicating that some of these removable polishes were depositional (Van Gjin 1986: 19).

"Few traces will be left unless the worked animal material was sufficiently resistant to cause a lasting polish either due to mechanical polishing of the stone surface or to possible gel formation." (Van Gjin 1986: 22)

Van Gjin suggested that the lack of the second 'fish polish' was the result of behavioural factors, fish with hard scales were not worked, and fish cleaning tools were used only briefly compared to the re-use of tools for other tasks.

Van Gjin's research effectively identifies a whole range of problems with polish identification:

- 1) Polish does not always form
- 2) Several different polishes were formed as the result of performing the same tasks
- 3) Not all the polishes were diagnostic
- 4) The polishes did not all survive well
- 5) The polish that formed most frequently and survived best, was 'diagnostic' of a different worked material from the one on which it had been used!

Thus, although polish may occur more frequently than edge damage and may be a more reliable indicator of use, there are very serious problems in the interpretations of both kinds of evidence. Further doubt arises as the result of the blind tests discussed in Chapter 4.

Quantification:

Attempts have been made to quantify both polish and edge damage data.

Edge damage:

The quantification of edge damage has been attempted by numerous workers, frequently looking at different features (Wilmsen 1968, Tringham *et al* 1974, Odell 1977, 1979, Cotterell and Kaminga 1979, Hayden 1979, Lawrence 1979, Odell and Odell-Vereecken 1980, Akoshima 1987). A variety of measurements have been made, becoming progressively more complex and detailed. Unfortunately, the problems of edge damage presence and usefulness discussed above mean that, however accurate the quantification becomes, the utility of such an approach is flawed. It must be stressed however that the description of edge damage features has generally been more objective than the description of polish. This has allowed the reworking of the data (Odell 1977: 121), which is of great importance in functional analysis where it is usually impractical, if not impossible, to re-examine the primary data.

Polish:

Attempts have been made to quantify polish. The use of image processing will be treated in appendix D (along with Keeley's measurement of polish differences (Keeley 1980)), as the present study has included an attempt to use an image processing technique. There are two other published attempts to quantify polish data, one using interferometry, the other profilometry.

Interferometry is an optical technique for measuring small changes in the surface topography of an object, using a split beam of light to produce an interference pattern. This technique allows the precise depth of surface features in a polish pattern (pits and striations) to be measured, and a type of contour map of the polish to be made. The

technique is very time consuming, although Dumont believes that it may provide an objective measurement of the differences between polishes (Dumont 1982, 1983, 1985).

There are some major problems with interferometry. The technique does not appear to be suitable for the types of coarse material examined in the present study. Dumont states that the object being studied must have a surface which is sufficiently regular to produce an ordered interference pattern. Unpolished flint is too irregular (Dumont 1985). Given this limitation, many 'problem' pieces with only a limited degree of polish development, would also be unsuitable for the analysis.

The time-consuming nature of interferometry means that it is "impractical" to study an entire piece, "let alone a whole assemblage" (Dumont 1985: 53). There is as yet no database of known interference patterns to work from, and Dumont awaits a "technological breakthrough" to speed the method up, and make it practical.

Recently S. Beyries and F. Delamare have investigated the technique of three dimensional profilometry (simply a technique to obtain profiles of the surface of an object by running a stylus across it) to create a digital image of tool surfaces. There are a number of serious technical problems with this method. The equipment for profilometry is normally used for such tasks as searching for cracks on metal surfaces. This means that the equipment has been developed to search for abrupt changes in otherwise relatively smooth and uniform surfaces. The rough surface of flint is very hard to follow without either scoring the surface, or at the other extreme, jumping over features. The process seems to have several inherent inaccuracies. There is the initial problem with the stylus, and also the problem that the process is essentially one of contouring. These two problems mean that the final picture has been smoothed out. Although pleasing three dimensional diagrams of the surface can be produced, it is not clear whether the amount of information lost in the process makes it more than an expensive and time-consuming technique for little practical gain. (Beyries, Delamare and Quantin 1988)

To some extent these techniques have suffered from the same problems as the quantification of edge damage. The detail provided by quantification has not helped to elucidate the basic problems of functional analysis, but has involved great expenditure of effort for little gain.



4 "Blind Tests"

The nature of a "blind test":

The basic purpose of blind tests has been to test the ability of functional analysts and their methods. In principle it consists of a number of tools being made and used by someone other than the functional analyst(s) involved in the test, without their knowing what is being done (hence the term "blind"). The analyst(s) then has to attempt to produce information about the use of the tool. Various scoring systems have been used to measure the success rate of the analyst(s) involved. In addition various agreements have been reached between tool user and analyst to set some parameters for the test. A brief outline of the major published tests will be given. Because of the importance of these blind tests to functional analysis a detailed discussion is given.

An additional purpose of this examination of blind tests is to establish the level of accuracy which can be normally expected in functional analysis. From the parameters established here, and the general theoretical expectations for the method, it should be possible to predict levels of precision, and develop a method that takes these into account.

The Keeley/Newcomer blind test:

The first blind test was done as Newcomer was not convinced by Keeley's claims for his method of analysis. The test was published several times (Keeley and Newcomer 1977, Keeley 1980, Newcomer and Keeley 1979), and set the pattern for later testing of functional analysis.

The points agreed before the test were as follows (Keeley 1980: 350):

- "1) a small number of implements would be involved (15 was the number finally agreed upon);
- 2) some implements would be retouched others would not;

- 3) these tools would be used in tasks "relevant to prehistoric hunters";
- 4) no "trick" specimens would be introduced by Newcomer (the judgement of what was a "trick" being left to him);
- 5) the test results would be published regardless of result."

The test results were seen as evidence that Keeley had indeed developed a powerful method for functional analysis (fig 4.1). Keeley admitted that lessons had been learned in the process, and that some of the mistakes made would probably not be repeated. (One of these mistakes was a failure to examine the entire circumference of one of the tools, an area of about 6mm was missed out (Keeley 1980: 70). Although Keeley explains why this happened, it is quite likely that in the course of the examination of a large archaeological sample this type of error could be repeated.)

Keeley's test scores

Used Area		Motion		Material	
14/16	87.5%	12/16	75%	10/16	62.5%

Fig 4.1

Odell's tests:

This test was conducted in direct response to Keeley's "blind test" in an attempt to demonstrate a) that the "Low Power" method was as useful a tool as the "High Power" approach, and b) to demonstrate the greater speed of his method. The published paper actually incorporates the results of two tests, one undertaken with a sceptical student and one with Odell's wife. (Odell and Odell-Vereecken 1980).

31 tools were utilised by Odell-Vereecken and 18 by the student. Odell also appears to have gained more insights into his interpretation of traces in the course of the test, and believes that at least one mistake would not have been made outside the "blind test" situation. The argument that an analyst is more likely to be able to infer what a tool was

used for if he/she knows what prehistoric people were likely to be doing is somewhat circular (Odell and Odell-Vereecken 1981). The results show a similar pattern to HP tests, with a poor result in the identification of material (Fig 4.2).

Odell's test scores					
Used Area		Motion		Material	
24.5/31	79%	21.5/31	69%	12/31	38.5%
Fig 4.2					

Shea's tests

Related to Odell's test in that they refer to the use of the "low power" are a series of six tests done by Shea. Unfortunately, although Shea claims very high scores he gives very little detail on the actual test parameters. The average time to examine a piece was 7.7 minutes, retouched pieces took less time on average, and Shea worked on a wide range of materials, some of which he had never looked at before! This led him to believe that the edge damage approach is not sensitive to the different "brittle isotropic microcrystalline rocks" (Shea 1988: 71).

Shea's test scores		
Used Area	Motion	Material
97.5%	91.5%	88%
Note that motion is given from a range of 16 possible answers, and material from a range of 12		
Fig 4.3		

These controversial claims should be supported by more than a numerical analysis of his results, as not only are the scores high, but most other analysts have found that edge damage traces do not occur sufficiently often to give such complete results. Tringham noted the difficulty of applying the "low-power" method to retouched pieces, and many studies, including this one, have noted the differences in wear traces between even very similar tool materials.

Shea does not support his claims, or even explain them, other than by stating that the "low-power" method is better than generally believed. Both the method developed by Grace (Grace *et al* 1988; Grace 1989) and the method developed in this study use evidence from both "low-power" and "high-power" work without achieving these scores.

There is a further problem. Shea's results for worked material are based on a limited range of material classes (Fig 4.4). This effectively makes his score for worked material artificially high, as his options are reduced.

Material worked

- 1: Soft Animal, ie meat, hair
- 2: Soft Vegetal, tubers, grasses, etc
- 3: Medium Animal, fish, frozen meat
- 4: Medium soft vegetal, fresh conif wood
- 5: Medium hard vegetal, fresh dec. wood
- 6: Medium inorganic, eg clay
- 7: Hard animal, bone, antler, shell
- 8: Hard vegetal: dense tropical wood
- 9: Hard inorganic: stone etc
- 10: projectile
- 11: hand
- 12: haft

After Shea (1988:68), Fig 4.4

The range of material classes is apparently based on relative hardness, yet must have many areas of variation and overlap. As mentioned below, Grace *et al* (1988) demonstrate that it is possible to distinguish between

bone and antler by edge damage features, although probably at a level of magnification unavailable to Shea. This raises the question as to how Shea can distinguish between his 12 material classes, as they appear as rather arbitrary classes.

One important point that Shea raises is that if blind tests are used as tests of accuracy, they are as much tests of an individual's accuracy as they are of a particular method (Shea 1988: 67). This is a point that has perhaps been forgotten in the debates over methods and validation by blind testing.

Gendel and Pirnay:

This test was conducted specifically to provide an "independent evaluation of the method of microwear analysis described by Keeley" (Gendel and Pirnay 1982: 251). This test had the added proviso that the material from which the tools were made should be comparable to that with which the analyst was familiar. Pirnay made the tools for Gendel to analyse. Tools were cleaned in soap and water to remove any residues of use.

Gendel's test scores

Used Area	Motion	Material
21/23 91%	19/23 82.5%	17/23 74%

Fig 4.5

The results (fig 4.5) appear to be a further confirmation of Keeley's method, being even more accurate. The degree of success possibly reflects the advantage of familiarity with raw material. It should however be noted that the scoring system used was generous, there was for example no attempt made to distinguish between bone and antler, and a half credit was given for such answers as "whittling wood or cutting plant material" (Gendel and Pirnay 1982: 255), two different activities as

well as materials. In effect the authors seem to have decided that not only are bone and antler indistinguishable (and probably hard wood too (ibid 256)), but that whittling wood and cutting plant material are nearly the same. This last error occurred three times.

Tübingen - The "Multi-Analyst Approach"

This test was conducted by four analysts, A. van Gjin, E.H.Moss, H.Plisson and P.Vaughan on 21 replica tools produced by G.Unrath and L.R.Owen (Unrath *et al* 1986). The analysts selected all used high magnifications, and all had "above average lengths of experience" (Unrath *et al* 1986: 120).

The Test

Each of the analysts was given one week in which to study the tools before sending them on to the next analyst. No communication between the analysts was permitted. The flints comprised 17 North European chalk flints and four fine grained Turkish flints. They were used for a wide range of 'real' tasks. The test produced some interesting results. Scoring (Fig 4.6) was done by all six of the

"Multi-Analysts" average test scores						
	Used Area		Motion		Material	
Specific	87/112	78%	62/128	48%	31/120	26%
Group*	88/122	79%	76/128	59%	59/120	49%
* see fig 4.7						
						Fig 4.6

authors working together, and was classified following a fairly complex system (Fig 4.7), which has not helped comparisons with other tests.

Used Areas:	A: Specific
	B: Unspecified
	C: Wrong/Missing
Motion/Activity:	D: Specific
	E: Group
	F: Unspecified/Unknown
	G: Wrong/Missing
Contact Materials:	H: Specific
	I: Group*
	J: Relative Hardness or a multiple answer with one part right
	K: Unspecified/Unknown
	L: Wrong/Missing

* Group means bone/antler/ivory, meat/fresh hide, hide/leather in various states, butchering fish/mammals/fowl, wood/plant and rock/shell.
(Unrath et al 1986: 149)

Fig 4.7

The complicated method of scoring was based on the "concept of levels of certainty or degrees of accuracy" (Unrath *et al* 1986: 149), deliberately avoiding right and wrong. While this makes it difficult to compare their results, it is a more accurate reflection of the problems encountered.

The most useful part of this blind test was the analysis that was presented with it. Although it is possible to argue about the exact scoring system used, the authors make a serious attempt to assess why and where they went wrong. They point out a list of problem areas involved with the motion/activity and the contact material. These are:

- 1: The difficulty of recognising weakly developed polishes
- 2: The difficulty of distinguishing between use traces on the one hand and manufacturing, prehension and hafting traces on the other.
- 3: The difficulty of perceiving trampling and hafting traces.
- 4: The difficulty of separating the different parts of a multi-use tool.
- 5: The careless overlooking of obvious traces.

- 6: The fact that different worked materials produce traces that are diagnostic to different degrees.

To this list must be added the general difficulty of distinguishing different contact materials, as in this respect the results are not very impressive.

Institute tests: A, Newcomer *et al*

There are a series of three published tests that were conducted at the Institute of Archaeology, London. This involved a total of 30 pieces, done in groups of 10 with different conditions for each group. The tools were analysed by a group of analysts, all students at the Institute. (Newcomer *et al* 1986) The test results are not directly comparable to the other tests except for the first set of 10. The remaining 20 were modified tests, designed to investigate the problems presented by the first series.

The First Test:

Institute test scores A

Used Area	Motion	Material
35/50 70%	21.5/50 43%	8/50 16%

(Partially correct scores = 0.5)

Fig 4.8

As the experience of the analysts varied, they checked the total scores for each individual against the number of years experience. Although the best score came from the most experienced, and the worst from one of the two least experienced, the second best score came from the other of the two least experienced analysts. In addition a "technologist" using a

hand lens scored very well, although he did not attempt to describe worked material (Newcomer *et al* 1986: 207).

The second and third test series:

After the poor results of the first test, two more sets of ten pieces were examined. The tools in the first of these sets were simply rubbed against their contact materials, to test the hypothesis that different worked materials always produced different polishes. The results were again poor, but it was suggested that this was the result of the unusual activity conducted. A third test was carried out, with all pieces being used to slice materials. The analysts were told what the materials were, and that the tools were paired. Despite these pieces of information results were still poor. (Newcomer *et al* 1986: 215)

These three tests cast serious doubt on polish identification, leaving Newcomer believing that the earlier test he had conducted with Keeley had been too optimistic, and that there was no "convincing demonstration that anyone can consistently identify worked materials by polish type alone" (Newcomer *et al* 1986: 216). This contention was supported by the results of a textural analysis conducted by Grace.

Response

The Newcomer *et al* paper has provoked a fierce debate (Moss 1987; Bamforth 1988; Hurcombe 1988; Newcomer *et al* 1988). The main criticisms of the Institute work arising from this debate are:

- 1) The image processing methods used by Grace to support negative test results were poor.
- 2) The first batch of tools (1-10) were used for a very short time - probably for a shorter time than most archaeological pieces.

- 3) The term 'polish' was not defined, and the view expressed by Newcomer *et al* that most functional analysis relied solely on polish identification was inaccurate. It involved the setting up of a 'straw man'.
- 4) The Institute tests ignore the results of other tests, and set themselves unreasonable targets.

Other points were raised some of which are disturbing, including a complaint by Moss that results were misreported (Moss 1987: 474). Others are minor, such as Moss's statement that the Institute analysts failed to replicate other test conditions by using different cleaning methods and equipment. It should be noted in this context that Gendel and Pirnay's high scoring work was conducted using the same (Olympus) equipment as the Institute analysts.

Image Processing Problems:

Moss suggested that the 'polish' examined by the image analysis included large areas of unpolished surface (Moss 1987: 478). This was the most serious potential problem with the image analysis technique, and has since been resolved by the details published in Appendix 1 of the Newcomer *et al* 1988 paper. This makes it clear that the polish examined was taken from very small patches of polish.

Hurcombe (1988: 4) and Bamforth (1988: 12) both criticise the limited data that the image processing technique tests. While Newcomer *et al* (1988:26) state that the image processing technique must work because it reliably separated unused from polished surfaces, this does not fully address the problem, as the purpose of such analysis is to differentiate between polishes. The contention that the technique manages to distinguish between 'polish' and 'no polish' more reliably than human vision (Newcomer *et al* 1988: 26), is deeply flawed. The polish and

unaltered flint surfaces have to be visibly different to begin with as "The texture analysis does rely on the analyst locating the polish" (Newcomer *et al* 1988: 28). In other words the technique can reliably measure the difference between polish and unaltered flint surface that the analyst has already perceived. This can hardly be described as being more accurate than the ability of an analyst to perceive polish.

Much of the image processing work is perfectly valid, but the difficulties of applying such a method are many, and as is suggested in appendix G, an image processing approach should involve more than one analytical method.

Tool Use:

Moss states (Moss 1987: 474) that of the 30 pieces examined 25 had little or no polish, the result of short use periods. Bamforth (1988: 18) shows that this can be a serious problem, as his data suggest that analysts consistently produce better results the longer a tool is used. In answer to this criticism Newcomer *et al* point out that their more successful second test set involved tools that were on average used less than those in the first test. Average use time for the first set (where measurable) was 14.6 minutes, close in fact to the average length of use for the Edinburgh blind test, 14.8 minutes.

Critics have made much of the 'unrealistic' nature of the Institute tests and have also criticised the short use of the test tools. Moss implies in a dangerously circular fashion that it is easier to interpret archaeological pieces as they are normally used for longer. This opinion is based on her experience with archaeological material, yet the situation should not be seen as so clear cut. The case studies examined in this project suggest that many tools were only used briefly. Tests should include this potential variability in the length of time a tool is used. However in one sense Moss is correct to criticize this short tool use. The Institute test

set out to prove the accuracy of polish identification, it is therefore necessary to study pieces that have polish.

Polish and Straw Men:

The Institute test set out to examine the accuracy of 'polish' identification. It was demonstrated that the accuracy of identification from 'polishes' was poor. Yet at no time did they discuss in detail what they meant by 'polish'. As the primary thrust of their investigation was apparently concerned with polish, this was a serious omission. A discussion of 'polish' is given below (chapter 5), but it appears that in this paper Newcomer *et al* deliberately used an extremely simplistic definition, that deliberately took no account of the notion that polish 'types' are just a convenient shorthand. (The failures of such a shorthand are discussed in chapter 5) In this sense they are indeed "challenging a straw man" (Bamforth 1988: 21) and Bamforth is correct to note that more features, both details of polish patterns (pitting, distribution, etc) and non polish attributes (edge damage, morphology, etc) have been used by other analysts in their work. However this research has not simply led to "the rediscovery of problems that were already recognised and for which allowances had already been made in functional interpretations" (Hurcombe 1988: 1). It is not accepted that in blind tests analysts are encouraged to be more specific than usual, and less cautious. Most analysts have repeatedly stated that polish is the single most important part of their analysis and that the 'Keeley Method' is based upon this principle. Most analysts who have published blind test results appear more specific and less cautious in their archaeological analyses (cf Grace 1989: 131).

Other Tests:

The last general criticism is that the Institute test ignored the success of earlier tests, and set unreasonable standards. The first part of this criticism is no longer true, Grace has commented on and compared other tests with the Institute tests (Newcomer *et al* 1988; Grace 1989). His use of the Institute scoring system is however rather harsh. For example, if Keeley had known that an answer of "possibly wood" would give him no points, he might well have plumped for "wood" (Grace 1989: 131).

A slightly ambiguous sentence in Gendel and Pirnay states that "the raw materials utilized by the experimenter (Pirnay) were to be comparable to those with which the wear analyst (Gendel) was familiar." (Gendel and Pirnay 1982: 251). Grace clearly reads this as meaning that the materials worked were known (Newcomer *et al* 1988: 26, Grace 1989: 128). It has however been read here to mean that the lithic materials from which the tools were made should be comparable. This interpretation is supported by the statement "the specific activities and materials to be worked should be unknown to the microwear analyst." (Gendel and Pirnay 1982: 252) Grace further suggests that his understanding of the paper implies that Gendel and Pirnay limited the range of materials studied to only three, hide, wood, and bone/antler (Grace 1989: 128). Gendel clearly was unaware of this; in addition to those materials he included plant and meat in his answers! That brings the number of materials up to five, and Gendel's score remains better than those achieved in the Institute test where analysts were told that there would be five paired materials used (nos 21-30, Newcomer *et al* 1986: 215).

The issue of unreasonable standards can be separated into two components. In one sense the Institute approach is valid, in that it is essential to remove some of the ambiguity which surrounds blind tests. As a means to using such tests to improve methodology (Newcomer *et al* 1988: 25) this harsh approach is useful.

The criticisms are valid in another sense in that the Institute system does encourage over-precise identification where the analyst may not be certain, and the best answer may be "unknown" (Bamforth 1988: 17). The challenge to straw men reappears with Newcomer's statement that a well developed polish should never be mistaken for anything else if polishes are indeed diagnostic (Newcomer *et al* 1986 216). This supposition has never been stated elsewhere, and polish types have frequently been stated to overlap. Newcomer's contention implies a perfection in evidence that no discipline would claim. If the purpose of these tests was truly to verify that well developed polishes are diagnostic, then the polishes on the tools should indeed have been well developed through long use.

Conclusion:

In this study the general principle of Newcomer *et al*'s work, that polish is not the sole or best method for wear analysis, and that polish 'types' do not as such exist is upheld. However the Institute tests had confused objectives, between a) stimulating means of methodological advancement (where it succeeded), b) proving polish methods, and c) verifying an archaeological technique. Allegations of misreporting, the repeated creation of "straw men" to challenge, the failure to produce the textural analysis data at the right time, and the critical approaches to other's work, either by misunderstanding basic points, or by applying a scoring system to a different set of rules, all detract from what is otherwise a useful piece of work.

Institute Tests: B, Grace *et al*

Grace (Grace *et al* 1988, Grace 1989) reports a second series of tests conducted to test the method developed at the Institute in the light of the problems observed in the first set of tests. These tests produced very good results, and are based upon a high power method that does not use individual polish types as its main means of identification (Grace 1989: 135).

In these tests it is explicitly stated that the aims of the new approach are to standardise the methodology and to "test the limits of its interpretations" (Grace *et al* 1988: 218). The means to test these limits is the blind test, which is also used to develop the method by testing each variable for its diagnostic value (Grace *et al* 1988: 218). It is argued that by using their new approach, which treats polish as only one variable in a multi-variate method, a better level of accuracy is obtained. While the experience of the analysts was generally much lower in this series of tests, the results were greatly improved. Contrary to many other studies (for example, Shea 1988, Gendel and Pirnay 1982) Grace *et al* demonstrate that it is possible to distinguish between antler and bone, in at least some cases. As this distinction is not made on polish, but on edge damage, it simultaneously points out the flaws in over-reliance on polish and questions why, given the high level of accuracy in other details, Shea was unable to distinguish between antler and bone? The authors strongly suggest that their approach is vindicated by the scores achieved (Fig 4.9)

Institute test scores B					
Used Area		Motion		Material	
79/80	99%	72/80	90%	40/80	50%
(Partially correct scores = 0.5)					
					Fig 4.9

It remains the case that although the results are significantly improved over the previous year's tests, the actual identification of specific worked material remains at only 50%. This figure is somewhat artificial, for as Grace *et al* state, "as the evidence from use-wear varies on different tools, the interpretation can only be made to the level that the evidence allows" (Grace *et al* 1988: 222). In a genuine archaeological application a complete interpretation including worked material would not always be possible. While that principle is absolutely agreed with in this study,

it conflicts with Newcomer's statement (Newcomer *et al* 1986) that polishes should always be unmistakeable and diagnostic.

Edinburgh blind test:

Although the method developed in the course of the writer's own research is not designed to produce information on specific worked material, it was felt that a blind test should be conducted to investigate how well the method worked in such conditions, and also as a learning aid. It was felt that potential improvements in the technique would be observed, areas of weakness noted, and also that it would be useful for the analyst to see material not produced by himself.

The test:

A series of 10 pieces of chalk flint (Brandon and Danish) were selected by Bonsall from a large collection shovelled up from the knapping room floor of the Artefact Research Unit, Edinburgh. The pieces were the result of several knappers' activities over an extended period, and had been subjected to pushing around, walking over, etc. Bonsall retouched some pieces and gave all except one piece to the analyst to draw before use for the recording system. In this respect the test was not completely blind, but all subsequent activity was unseen by the analyst.

It was understood by the analyst that Bonsall was free to make the test as difficult as he wished, and absolutely no limitations were placed upon what he did to the pieces. The tasks conducted and marks scored are summarised in fig 4.10. The test pieces were not given to the analyst at one time, but in three stages. The analyst attempted to treat each piece as an archaeological sample, spending no more time on them than normal, and preparing them in exactly the same way. The only difference was that the analyst did push his interpretations further than he would normally feel permissible. In this sense the analyst was "encouraged" to be less cautious and more specific than usual.

These results have a number of caveats attached. Some of the details are significant, so a brief synopsis will be presented here.

Edinburgh Test			Area Motion Hardness Material			
Use						
1)	N 3	Groove Antler	1	1	1	1
2)	N 4	Saw/Cut Wood	1	1	1	1
3)	N 4	Rub Wood	0	0	0	0
4)	N 6	"Reap" weeds	0	0	0	0
5)	N 7	Not Used	0	0	0	0
6)	N 8	Whittle Wood	1	1	1	1
7)	N 9	Peel Potatoes	1	1	1	0
8)	N 9	Cut/Dice Carrots	1	1	1	0
		on a wooden board				
9)	N 10	Scrape Bark	1	1	1	0
10)	N 11	Shave Antler	1	1	1	1
11)	N 12	Saw Antler	1	1	1	0
12)	N 13	Strike sparks	1	1	1	1
		from iron pyrites				
out of 12 uses			9	9	9	5

Fig 4.10

Tool N 3: The tool was used for only a short period of time, and the analyst interpreted the resulting traces as being the result of delicate, rather than brief, work. The correct hardness was established from the edge damage on a thick edge, not from the poorly developed polish, which indicated motion of use. Antler was the only material that matched this hardness.

Tool N 4: the tool was used to cut/saw wood for 5 minutes, then the same edge used to groove wood for 5 minutes. The analyst did not observe this distinction. Secondary use of the face of tool was not observed due to carelessness. The analyst failed to examine all of tool properly.

Tool N 6: The area of tool 6 perceived as used was in fact the part held. The analyst did not recognise use due to the presence on that area of much non-use wear. Despite 45 minute use no traces were visible on that background.

Tool N 7: The analyst stated that he was "not happy" on the record sheet for tool 7, but went on to identify non-use wear traces as possible transverse use.

Tool N 8: Despite many technological traces the analyst had no problems with tool 8.

Tool N 9: The analyst noted both uses on tool 9, and correctly observed which was the longer use, and that the material was soft. It was then stated on the record sheet that "as an archaeological sample, he would not classify this piece as used, unless a pattern emerged of similar pieces" as the traces were extremely slight.

Tool N 10: The analyst stated soft wood as the worked material instead of bark. Bonsall stated on his record sheet that the bark varied in hardness, and said later that he had probably scraped some sap wood as well. It was felt that the answer probably gave the correct hardness.

Tool N 11: The analyst had no problems. Specific hardness was again calculated from edge angle in relation to edge damage, not by "polish type".

Tool N 12: The analyst was confused by Bonsall's prehension again. The correct use was noted, but it was suggested that the prehension area was either prehension or use of the dorsal ridge as a plane. The hardness of the worked material was evident, but the analyst did not attempt to define the specific material. Bonsall stated that he only used the tool for 2-3 minutes, and that it was probably blunted in less than half a minute.

Tool N 13: The analyst stated grooving stone, which in some ways was a reasonably accurate description of the activity. The tool had in fact been used to strike sparks from a lump of iron pyrites and the answer completely missed this intention.

Discussion:

This test produces a number of interesting points.

- 1) Despite a rigorous system the analyst was so pleased to have found traces on tool 4, that he never completed the examination of the tool. This is a warning to ensure strict adherence to the system.
- 2) The difference between tool users was significant. In his own experimental series, despite having looked for them, the analyst had noted the rarity (and poorness) of hafting/prehension traces. Bonsall produced marked traces on two tools by prehension.
- 3) The analyst received tool 7 after he had been told the answer for tool 9, a brief period of over-confidence with marginal/difficult traces ensued. This piece reinforces the analyst's normal description of such pieces as having traces caused by non-use-wear (NUW), which makes any further interpretation impossible, whether the tool was used or not.
- 4) The designation of tool 13 as used to groove stone indicates the analyst's familiarity with tools to carve microlite figurines. On seeing these traces he automatically interpreted them in the light of his own experience. This piece demonstrates the difficulties that we have in looking at the past; we can only infer from our own experience. It also demonstrates the need to be constantly open-minded about tool use, and not to limit horizons to the usual set of activities. Finally, this tool also shows very clearly that, even when a functional analyst is technically correct in all four levels of interpretation, there is still a fifth level of interpretation, what the original user was actually trying to achieve. This level is obviously still more difficult than that of specific material worked. This problem will be discussed further below in the section on the purpose of functional analysis.

Overall the results of this test confirm the analyst's view that a limited level of interpretation is best, and that the evidence varies in quality from piece to piece. It should be noted that the analyst produced consistent results until the fourth level of interpretation, in that for each piece where area of use was correctly identified, motion and general

hardness were also correctly identified. In no instance was this done solely on the evidence of a polish type; indeed in two pieces the primary evidence was the edge damage. In both the cases of prehension error the problems were caused by the presence of polish traces. Despite this, the results at the material-specific level are slightly better than Keeley's according to Institute scoring methods.

Discussion:

The results of the Institute and Edinburgh tests are not the only doubt cast upon the method of polish identification developed by Keeley. Prior to this there had been a very serious criticism in an article by Holley and Del Bene (1981), which a) suggested that the scoring system used was poor, and b) that the results for material worked need not have come from polish identification, but could have been inferred from information available to the "low power" method.

Of tests in general:

Blind tests have come to play an important role in functional analysis. However there are some very clear problems in their use. A number of these problems have been picked out in the preceding discussion. They can be summarised as:

- 1) How representative are the small test samples?
- 2) How "blind" are the tests?
- 3) How relevant are the tests to archaeological material?
- 4) How should tests be scored?

1) The most significant thing that can be said about the small sizes of the samples is that it is hard to gain positive information from them. Holley and Del Bene's criticism of the Keeley - Newcomer test is the sort of

criticism that is very easy to make with regard to such small samples (Holley and Del Bene 1981). While it may be unlikely that Gendel and Pirnay's high success score was the result of luck, it is not impossible with such a small sample.

2) Odell suggests that "blind" tests are more difficult than archaeological samples, because in an archaeological context we know certain background information that may help us in the interpretation of traces. That is a very dangerous and circular position to take. It may be entirely wrong. Analysts are equally likely to be able to guess what a modern tool user is likely to test on, particularly as he is not normally allowed "tricks". No rational tool user for a blind test is going to dominate the test with unreal or obscure uses. The input of at least some useful information from the tools, such as gross shape, edge angle, and the location of traces allows many reasonable inferences (or "guesses") to be made that are unassociated with polish diagnosis.

However, as argued below, the purpose of functional analysis is not to conduct blind tests, but to further archaeological research. As such, archaeological samples can in some ways be easier to analyse in that the high levels of individual accuracy per tool are not required. It may be that few individual traces can be interpreted in detail, but that useful information can be gained from the overall patterns of traces. This area of debate will be considered fully below.

3) It has to be said that even good scores in "blind tests" are not an indication of a similar rate of success on archaeological material. Archaeological material is affected to varying degrees by post-depositional effects. Prehistoric tool users were under no constraints to use a tool for a reasonable length of time, sufficient to produce wear. On the other hand they might have used a tool for as long as it kept working, possibly for months. The variability in length of use is far less controlled than it is likely to be in a blind test. In addition, complications of breakage and re-use of tools, effectively removing large quantities of information, could be commonplace. Furthermore, it is possible that

analysts looking at a small "blind test" sample might spend more time on each piece than they can on archaeological pieces.

4) There are a number of technical problems with the interpretation and scoring of tests; some being alleged to have been scored excessively favourably. The published tests are not easily compared, even the three sets of test in London are not published in a uniform manner.

If a consideration of all the tests is made (Fig 4.11), even using the Institute scoring system, Keeley's score for worked material remains close to that achieved by Grace *et al*. Grace *et al* vastly improved on results from their first test, but, at least in terms of worked material, they remain close to Keeley's results. (This is true despite the possibly unreasonable retrospective application of the scoring system.)

Overall Blind Test Results						
	Area		Motion		Material	
		%		%		%
Odell ¹	26/31	84	21/31	68	11/31	36
Keeley and Newcomer ²	14/16	87	12/16	75	7/16	44
Keeley/Grace/Knuttson ³	36/40	90	34/40	77	31/44	71
Newcomer et al	32/50	64	18/50	36	3/50	6
Newcomer et al ¹	35/50	70	21.5/50	43	8/50	16
Grace et al	79/80	99	72/80	90	40/80	50
Unrath et al ²	87/120	72	62/120	52	31/120	26
Unrath et al ¹	88/112	79	66/112	77	54.5/112	49
Unrath et al ⁴	88/112	79	76/128	59	59/120	49
Finlayson and Bonsall	9/12	75	9/12	75	5/12	42
<div><div>1 After Bamforth 1988</div><div>2 After Grace 1989</div><div>3 Keeley/Grace/Knuttson average, after Bamforth 1989</div><div>4 Unrath et al, group scores</div></div>						

Fig 4.11

All such comparisons between test series are extremely difficult. The different ways of interpreting results mean that different scores will be produced for the same test. Compare Bamforth's results for tests with

Grace's figures (Fig 4.11), produced by different scoring and interpretation of reports, and it can be seen that any attempt to directly compare these tests can only produce very approximate results. This is made worse by the different "rules" and circumstances of each test. The evidence for tool function can be of variable quality. An unretouched tool, made of a fine grained homogeneous material and used for a long time on a worked material that produces very clear traces is easy to interpret. A retouched tool made of a variable coarse material and used for a short time on a material that produces few traces is very difficult to interpret.

Conclusions:

From the evidence of the blind tests it would appear that no method of functional analysis is infallible, and on occasion every method may be incorrect. On the positive side it does appear that functional analysis can produce some information. Part of the purpose of this research project was to develop a methodology that could make use of the degree of accuracy expected. It can be seen from all the results outlined in fig 4.11 that it is at the level of specific worked material that accuracy is most significantly reduced. If a measurement of general hardness of worked material is included accuracy is much greater (Fig 4.12).

Scores for assessment of "hardness"

Grace et al	90%
Finlayson	75%
Unrath et al	61%
Keeley	81%

Fig 4.12

Part 2

The pragmatic use of functional analysis

"A professor of mine once remarked that you could spend your life trying to explain why the earth is flat and be a total failure. He was right; if you ask a silly question, you can waste a lot of time." (Binford 1983: 195)

5 The Purpose of Functional Analysis

There is surprisingly little consideration as to *why* a functional analysis should be undertaken. Shea notes that use-wear analysis has made little contribution to archaeology, and that most of the simplistic interpretations (for example the fact that tools were used to process plant foods) given come as no surprise (Shea 1988). There are exceptions. In particular, the studies associated with the problems of the beginnings of agriculture using the evidence of "sickle blades" have a clearly defined objective (eg Anderson-Gerfaud 1983; Unger-Hamilton 1983). They have produced some very interesting information, relevant to the study of early agricultural developments in the Near East and not just of interest to functional analysts. At present, however, too much is done without apparent thought as to the purpose of the study. This criticism is most relevant to those studies where the sample size is too small to allow any meaningful data to be gathered (eg Coqueugniot 1984, 13 pieces analysed). This can be justified where a project was designed purely to test a method (eg Keeley 1980), although even in these cases the testing can be made more relevant if it is carried out within the framework of a larger project. Any technique, particularly one so fraught with problems as functional analysis, must be shown to have direct applicability, and not be developed for its own sake.

There are studies where the purpose of the analysis has been discussed. A paper that specifically addresses this question is Moss's article "A role for microwear analysis in archaeology" (Moss 1981).

In this short paper Moss suggests that typology is a "ready made sampling technique for wear studies" (Moss 1981: 88) and that typology should be "relieved of the burden it has had to carry in the name of style and function." To get to this position Moss assumes that "typology will automatically mean technology" (Moss 1981: 89), a statement that cannot be accepted. Most current typological schemes incorporate an unexplicit mix of morphological and technological features, with morphology normally dominant. While typology may be "inadequate for stylistic analysis" and "unsuited for strictly functional analyses" (Gendel

1984: 38), it cannot be seen as totally independent of these aspects. Function, style, morphology and technology are all closely inter-related, and cannot be easily separated. While we need not go as far as Bonnichsen, who believes that most typologies are based on the "form function hypothesis" (Bonnichsen 1977: 204) and states that:

"In view of the fact that 'artifact types' are created without the use of culture, cognition, or material theory, the type as it now exists must be rejected as an individual construct" (Bonnichsen 1977: 51)

we must use typology with extreme caution. Typology is inevitably concerned with grouping and so "variations in artifact forms have been ignored in favour of pursuing the normative view" (Bonnichsen 1977: 58). While we do not fully understand the rationale behind our typological grouping, we should not assume it has to be functional. That is not to say that typology is useless; it exists as a device to order the data to allow further analysis (Miller 1985).

Typology cannot therefore be used as a "ready-made sampling technique" as it very likely incorporates all these aspects, deliberately or not, in a disorganised fashion. Current studies of technology and of function may be able to begin to elucidate 'style', and will hopefully start to add *explanations* to our typological systems.

Moss argues that the correlation of broad tool categories with function is high, but the evidence of this is far from clear. Dumont argues that it is still too early to draw such general conclusions, as sites sampled are still too few, and range too widely in space and time. (Dumont 1985: 452) Indeed, if any conclusions can be drawn they are the opposite of Moss's:

"The functional analysis of the Mount Sandel and Star Carr lithic artefacts, when viewed in the broader context of other comparable studies, have indicated that no single tool type can be confidently correlated to either a single manner-of-use or worked material on a scale greater than that of the individual site." (Dumont 1985: 462)

In direct contrast to Moss, Dumont hopes to be able to isolate attributes of tool morphology that are non-functional and therefore stylistic. The current state of knowledge is such that no general statements concerning the correlation of tool "type" and function can be made. Evidence from

the case studies in the present research project suggest that tool type and tool function have an even more complicated relationship than Dumont suggests, with on-site variation in function.

This apparent lack of correspondence between tool morphology and function is supported by ethnographic evidence. With reference to the Ingalik in northern America in a major study of material culture, Osgood discusses two tools, a sewing awl and a skin puncture awl:

"the appearance of two tools is identical, but they have been listed separately because the natives think of them so, give them different names, and do not use them interchangeably." (Osgood 1940: 56)

Functional analysts will obviously have problems with the analysis of such pieces. The opposite also occurs, where men and women use different tools for the same purpose (Hayden 1977). It is also clear that problems exist for typological classification.

Moss lists a number of objectives for her work, some purely methodological following on from Keeley's work, but also some directly concerned with the objectives of her work:

"Was final Palaeolithic debitage used? Was tool function correlated to form? Could functional analysis substitute for other techniques, e.g., where bone and antler are absent, could it shed light on season of occupation?" (Moss 1983a: 9)

Moss identifies some more specific aims in direct relation to the sites of Pont d'Ambon and Pincevent which she selected as her case studies:

"What may be said about the transition from lower to upper layers at both sites? Were tools used in the same way or differently? Can trends in function be discerned? Does use-wear shed any light on the reasons for local or regional variation, duration or season of occupation? What relation does preserved organic material have to the evidence from the wear traces? How is use-wear related to raw material and techniques of debitage? At Pincevent, where habitation units are well defined, what can be said about the definition of activity areas? Are overlapping and off-site activity areas represented by use-wear? Can the life histories of tools be defined?

At Pont d'Ambon, can use-wear analysis shed light on the stratigraphy, or further define the relation between Magdalenian and Azilian? Can functional analysis define living floors where other means have failed? Where there are few tools, was the unretouched debitage used? Can the two sites be compared archaeologically through functional analysis? Finally can we extrapolate any of the information to other sites?" (Moss 1983a: 37)

This long list includes a number of realistic objectives. How appropriate Moss's method of functional analysis is to many of these questions will be discussed below. Moss's objectives are not only realistic, but potentially of general archaeological value, but unfortunately she simply presents them as this list, without exploring them in detail. Further discussion of them is buried in her text beneath her presentation of data. This prevents a clear distinction being made between data, interpretation and conclusion.

Odell (1977) spends some considerable time discussing his objectives in relation to his technique of analysis and gives a very general statement concerning his purpose:

"The microwear-analysis of the flint artefacts is designed to provide specific information on the activities practised and the materials worked on the site." (Odell 1977: 90)

This broad objective is common to most such studies, the difference here being that Odell continues by stating what this information is to be used to answer. He believes that through the use of experimental data and ethnographic models, questions may be answered regarding the functional nature of the site, how much faunal material may have been lost through chemical solution in the soil, the length of occupation, seasonality and the use-life and discard pattern of food processing tools. He later goes on to say that "functional data may be amenable to cultural interpretation" in that the analysis produces "reliable data intimately related to the behaviour of human beings" (Odell 1977: 579). The theory that the wide range of projectile forms found suggests that males of the De Leien Wartena culture married outside their immediate group, indicating exogamous marriage and matrilocal residence (Odell 1977:

577) is presumably such a cultural interpretation. The details of this may well be open to question, but the simple fact that Odell has raised these possibilities is to be commended.

Vaughan sets himself more limited goals:

"The interest in the most recent use-wear research has been to establish the functional composition of prehistoric stone tool assemblages and the site-wide distribution of activities which involved stone tools. Ultimately functional studies based on statistically valid samples from many sites will be instrumental in investigating processes of technological and economic change within the wider context of culture change and variation." (Vaughan 1981: 75)

This statement is more modest than Odell's, as it is an admission that functional analysis is still quite limited. It must be remembered that at present methods do have problems and sample sizes are both small and from a disparate collection of sites, both geographically and chronologically.

It is important to remember that these objectives are also matters that have to be considered in the interpretation of wear traces - there is a two-way relationship:

"Behavioural implications have to be considered, such as secondary use of tools, discard patterns, length of time the tools are used in relation to the species [of fish] cleaned, etc." (Van Gjin 1986: 24)

Some functional analysts can therefore be seen to have considered the objectives and relevance of their work, however:

"The capability of microwear analysis to achieve this ideal level of significance is directly tied to the quantity, quality, comparability and comprehensiveness of the methods employed in research programmes designed to study experimental and archaeological material." (Cook and Dumont 1987: 55)

It is the contention here that these aims are not fully realised, that analysts have rarely examined a sufficient "quantity" of pieces, that the use of polish "type" diagnosis prevents "comparability", and that the level of evidence required for the identification of these "types" reduces the "comprehensiveness" of such work.

Sampling:

Before considering the interpretation of a functional analysis, it is necessary to run through some of the sampling problems that arise in such studies. These can be broadly separated into those of a general nature, and those that particularly affect the functional aspects.

1: Excavation strategy

2: Type of lithic sample

1) In nearly all circumstances the functional analyst is going to be constrained by the excavation strategy used. Here there may well be aspects that cannot be avoided, such as disturbed or destroyed parts of the site, inaccessible areas, shortage of time and funds. These are, of course, common to all field-work. There are however aspects which can be improved to some extent for the purposes of a functional analysis. These include ensuring that the recording of the lithic component is as detailed as possible, that the largest possible proportion of the lithics are individually bagged, that as many lithics are recovered prior to sieving as possible, that sieved and unsieved material is separately bagged and that the recovery method is recorded. While in most cases it may be possible to identify the excavational and post-excavational damage as such, as many problem areas as possible should be avoided. All potential causes for the loss of information should be avoided. With regard to the recording, if it is desirable to conduct a functional analysis, then the time taken for adequate recording must be considered as part of the investment in that part of the work. This may not of course be a problem in many cases where for one reason or another, recording of lithics is already of a high quality. For all the reasons mentioned the

decision to involve the functional analyst should be made as soon as possible to allow decisions to be made concerning recording and storage.

2) The type of lithic sample that is recovered is also of importance. That the sample will already be skewed by both its deposition and its excavation is almost certain. Certain aspects of this are clearly understood.

1) The lithic component will not represent all the tools used. (Bone, wood, metal etc).

2) The component recovered will in most cases be just a sample of the site, and may well miss out activity areas conducted off the main site concentration. The normal tendency to excavate the densest lithic scatters may exacerbate this.

3) Tools used on the site may well be subsequently removed. Tools not used on the site may be discarded there.

4) Tools heavily used may well be subsequently resharpened, or reused in a different manner, possibly involving refashioning. Tools briefly used may easily be reused without modification.

5) The place in which tools are discarded may not accurately reflect where they are used. Subsequent activity on the site may further distort this picture with effects ranging from the accidental kicking of artefacts from place to place, to the retrieval of a suitable piece for re-use as in (4).

6) Areas of abundant raw material used to knap tools may have far more unused pieces than small sites (such as the upland hunting station). The abundance of unused pieces may mask other activities which were also important.

7) Due to semi-permanent or intermittent use of sites, a collection of stone tools may not represent a single use of

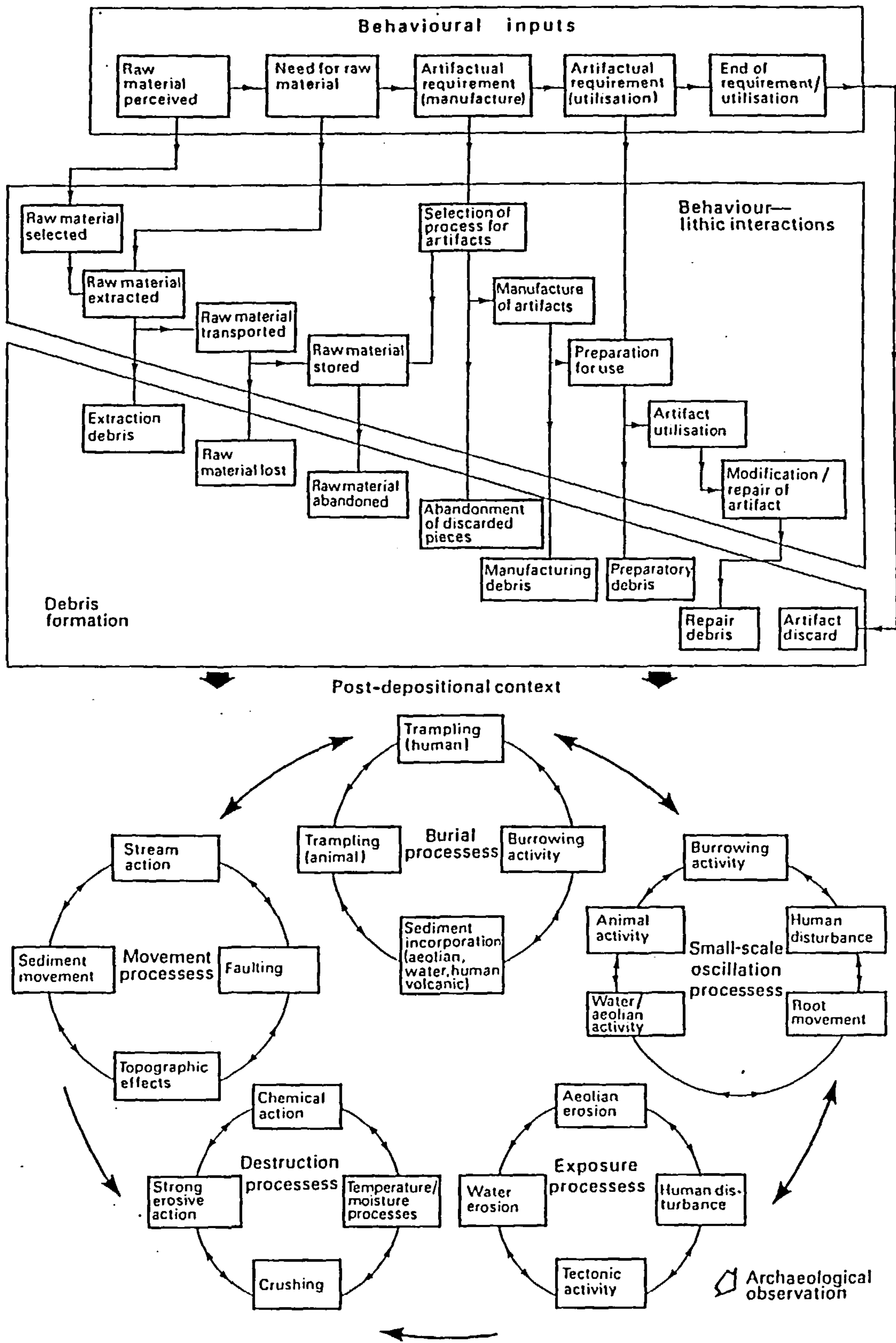
the site. Re-use of a site may not be for the same function as the previous occupation.

These problems of how the artefacts are accumulated and how samples are distorted are dealt with extensively in the literature, for example, Schiffer (1976) on the complexities of an artefact's "life", Binford (1981) on how artefacts accumulate, Foley (1981a) on the position of the "site" in its regional context, and Clarke (1972) on some of the many sampling problems that exist. Foley (1981b) describes the behavioural input and the post depositional effects that influence artefact distribution, preservation and visibility (fig 5.1). Frison (1979) discusses the re-use of artifacts after their original purpose, while Hayden (1977) states that notches, denticulates and scrapers are all used to shave wood, and represent different *sharpening* phases of one tool for one purpose. Jelinek (1976) discusses the fact that all that is left for the archaeologist is, except in very rare circumstances, the rubbish that is no longer wanted, not a ready-to-use tool-kit. In effect, behaviour is sampled by the post-depositional processes. After that, recovery by the archaeologist constitutes a further sampling.

These sampling problems all cause difficulties to the functional analyst. Some aspects are common throughout archaeology, others are specific to functional analysis. If it can be assumed that the excavation strategy will be designed to deal with the overall sampling problems, then the main problem areas that remain are as follows:

- 1) How large a sample is necessary to enable a meaningful functional analysis to be undertaken?
- 2) What type of information can a functional study provide, given the specific circumstances of the site?
- 3) What type of sample should be made, in terms of the tool types to be examined?
- 4) In the constraints of 1) and 2), is it possible or worthwhile to conduct a functional analysis?

Fig 5.1 After Foley (1981b)



Flow chart of artifact dynamics.

These questions are somewhat difficult to answer in advance of at least a trial study of the material, unless of course the answer to question 4) is unequivocally "no", due, for example, to the poor state of the site as a whole, or excessive post-depositional damage to tools (eg patination, water rolling, sand blasting and soil 'sheen').

The question of sample size involves a number of variables. In the event of a high proportion of tools being affected by post-depositional effects, the original sample must be increased to allow a sufficiently large sample of tools in a reasonably fresh state to be examined. If a large number of separate parts (eg 'activity areas' or buildings) appear to have existed on a site, then the sample has to be increased so that each area of interest is adequately represented. If any activity on the site appears to be masked by a high proportion of unused pieces (for example, as a result of large scale knapping activity), then again the sample size will have to be raised to see if any stone-tool-using activities are hidden by this mask. The most difficult case of all to demonstrate would be that a site was used exclusively for knapping, where the sample would have to be very large.

Dumont suggests that "the critical quantity is the number of artefacts with interpretable traces rather than the total number actually examined" (Dumont 1985: 463). There are two basic problems with this argument. The first is that there is useful information in the ratio of pieces with traces to those without, which pieces have traces, and so on. The second problem is the notion of "interpretable traces". This is a basic flaw of the "High Power" method. If only those pieces with apparently clearly diagnostic traces (the recognisable "polish types") are studied, the sample becomes enormously restricted, and almost certainly distorted.

The circumstances of the site pose important problems for the analysis. In many cases (for example on a very large site, or one productive in terms of lithics) it might only be worth doing a functional analysis after the *provisional* location of 'activity areas' by typological analysis. In those cases the functional analysis can be immediately pointed to sample specific areas for variation in tool use. The analyst can avoid areas of

apparent mixed or disturbed horizons where the use that can be made of functional information is relatively limited.

To answer questions 3) and 4) it is essential to consider the objectives of the functional analysis. The type of sample that should be made can only be decided once the purposes of the study are known. For example, if the primary interest is to narrow down the function of "sickle" blades, then it may be possible to simply sample all sickle blades without needing good contextual information. If, on the other hand, it was desired to test the hypothesis that separate activity areas existed, then very good contextual information would be needed, both two-dimensionally and chronologically. In addition it would be necessary to sample a very large proportion of the pieces in each location, not just the specific tools that appeared to define an activity area. The remainder of the site would need to be sampled to establish the background activities. If chronological changes in the use of a site were the aims of the investigation, then again good contextual information would be needed, and again a large background sample collected to ensure that, for example, the typological change that inspired the hypothesis of functional change, was not simply a stylistic change. The replacement of one typological series by another, even if the new series was used for different purposes, might not mean an overall change in site economy, if other tools took up the original functions of the replaced typological components. (The dangers of simplistic correlations between typology and function have already been discussed)

Vaughan's proposed sampling strategy (Vaughan 1986) does not concern itself with the wider theoretical problems of sampling, but instead concentrates on the practical aspects for functional analysis. His strategy consists very simply of a first step of discarding pieces that cannot be analysed - patinated, burnt, unsuitable raw materials, and then a second step, consisting of examining the edges either by eye, or with a hand lens at 10x. Pieces without continuous removals are described as 'plain pieces' and pieces with continuous scarring as 'scarred pieces'. He classes "Any debitage or debris exhibiting continuous large regular

removals" with the 'retouched pieces'. (Vaughan 1986: 183) If possible all the 'scarred' and 'retouched' pieces should be examined.

The justification for this method comes from some test studies conducted by Vaughan. From these he states that between 86-100% of pieces bearing microwear had continuous removals visible to the naked eye, while 35-79% classed as retouched or 'scarred' had no microwear. From this he believes that if all retouched and 'scarred' pieces are examined, while not all of the sample will have wear traces, nearly all the 'used' pieces will have been included (Vaughan 1986: 183). The actual figures from his case studies show that as many as 14% of the used pieces from one site were 'plain' (9.2% of the 'plain' pieces examined) (Mehrgarh, aceramic neolithic, Vaughan 1986: 184). While the 'retouched' and 'scarred' pieces consistently show higher proportions than the 'plain', as few as 22% of them were used in some cases (Gazel, Early Neolithic, Vaughan 1986: 184). Although "plain" pieces may have a lower ratio of use, that information should not be lost.

The further argument for either examining a small sample or ignoring the 'plain' flints altogether is hard to follow. In effect what Vaughan seems to argue is that the polish on the unscarred/unretouched pieces suggests that the thinner edged pieces (less than 45°) cut soft materials (hide or plants), while the thicker edged pieces with wear polishes "were resistant enough to withstand chipping even from relatively hard substances such as bone, antler, wood". He states that this evidence "corroborates experimental evidence showing that edge thickness is a decisive factor in the production of microflaking. Thus, one can simply examine a small sample of the plain debitage larger than 2cm (eg 20%) or even eliminate the group from consideration if the analysis time is too limited." (Vaughan 1986: 185)

Apart from the doubtful technique of using observations on the archaeological material to "corroborate" his experimental data, the rest of the argument is unsound. The fact that edge damage can be a poor indicator of use (as Vaughan's own experimental programme showed (1985)) is well established. It is put forward as an argument for relying on polish patterns. Why this should be used as a reason for not examining pieces without scarring is unclear.

The argument that unscarred pieces are less likely to have wear traces than scarred is perfectly reasonable, although not perhaps to the extent that Vaughan would like to suggest. However, by the very processes that cause scarring on some pieces and not on others, surely an entire segment of evidence is being discounted. From Vaughan's own work it would appear that all thin pieces used on 'soft' materials and all thick pieces would be excluded from his sample.

This sampling strategy appears to be designed simply to give the analyst the best chance of finding wear traces, regardless of any research aims. The need for such a design is presumably the result of the slow speed of the method used. Although optimising research time is a useful aim, to do so at the expense of complete sections of information is unacceptable.

The Interpretation and Description of wear-traces:

One problem (obviously crucial) in the study of stone tool function is that of the interpretation of the wear traces perceived. Newcomer has argued that there is frequently insufficient separation between observation and interpretation in functional analysis (Newcomer *et al* 1986 204). Much of this confusion can be put down to the use of Keeley's shorthand descriptions, such as "wood polish", etc., designed originally to describe, in brief, the whole array of features that Keeley regarded as diagnostic of, in this case, wood working. An over simplistic use of these terms has undoubtedly led to some confusion, and the use of these terms in the description of wear traces presupposes an interpretation that may not be appropriate. Juel Jensen, in her study of Danish denticulate tools has brought attention to the problems of this terminology, having found different "polishes" on different areas of the same used edge on tools. (Juel Jensen 1988b)

This problem has, to a degree, arisen out of a failure to appreciate that Keeley's polish descriptions were simply meant to be a shorthand description.

"The actual appearance of a microwear polish can be described in terms of its brightness or dullness (that is, how much light it reflects) and its roughness or smoothness, as well as the presence or absence of

certain topographical features, like pits, undulations, and so forth. Since the appearance of the microwear polishes proved to be highly correlated with the material worked, it became convenient to refer to them simply as "wood" polish, "bone" polish, and so on." (Keeley 1980: 22-23)

However the use of such a descriptive shorthand is always dangerous, particularly where, as in this case, the interpretation of traces is problematical. The results of the first "blind test", although scored and interpreted favourably, cast sufficient doubt on this correlation to suggest that the use of this shorthand may well be inappropriate. The admitted areas of overlap, between for example antler and wood (Keeley 1980: 58), or antler and bone, make it clear that using a shorthand which appears to presuppose worked material could very easily be misleading.

Odell's attribute recording (dealing primarily with edge damage) is an example of a far better design strategy for recording data for analysis. This is the case for both analysis by the original researcher, or analysis by any researcher wishing to re-examine the data, without having to spend the time on another microscope examination of the artefacts. Odell criticises the use of "types" of traces for three major reasons. Firstly, the types are imposed on the data by the researcher. Secondly, the individual elements that go to make up a "type" can vary from instance to instance in that "type" without proper control by the researcher. Thirdly, the designation of "types" actually hinders the study of how individual elements behave in relation to one another (Odell 1977: 115). Although Odell is discussing the use of types in relation to edge damage, his points are equally valid in relation to polish "types", perhaps more so, given the difficulty of describing these polish "types".

Cook and Dumont suggest that:

"In fact, it is probably naive to imagine that quantitative assessment will ever satisfactorily replace qualitative description based on observation, photomicrography and the judgements of experienced analysts." (Cook and Dumont 1987: 54)

While it is reasonable to assume that quantitative description may never entirely replace qualitative description, we must endeavour to ensure that our descriptions are as good as possible. The difficulties of describing polishes, and the tendency to use derivations of Keeley's shorthand has to a great extent hindered the good presentation of data. It is impossible to be able to judge the accuracy of an interpretation with such descriptions. The use of photographs, frequently poorly reproduced, and often of an unlocated spot on a tool, helps little. Even descriptions of what makes up a polish are difficult to use objectively. Anderson-Gerfaud uses a number of terms to describe polishes, "puffy"; "puffy" with "lumpy", giving a "pocky" appearance; "vitreous-appearing" as against "vitreous". She also makes use of the description "greasy" that Keeley first used (Anderson-Gerfaud 1983: 90). These descriptions are very subjective, and while Anderson-Gerfaud presumably knows what she means, the use of such terms cannot be seen as producing easily comparable data.

With the use of these polish types comes the serious problem of the separation of "observation from interpretation" (Newcomer *et al* 1986: 204). It is indeed hard to separate the two when the description of what is seen is given as, for instance, "wood polish". The interpretation has effectively already been determined.

Newcomer *et al* continue by observing that the level of interpretation is often far greater than the evidence would seem to allow. They cite Buller's 1983 study where it was stated that notched tools were used at El Wad to cut tendons (Buller 1983: 110). Newcomer *et al* point out that this reconstruction is made without any supportive "primary evidence in the form of photographs, drawings or even a description of an experiment showing that a replica of the tool could be used this way!" (Newcomer *et al* 1986: 204)

Dumont, who uses simple polish "types" in his analysis, has similar problems. His own experimental work is limited and, while he uses the term "meat polish" he admits that he failed to produce a recognisable meat polish on the Irish flint with which he experimented. Furthermore he could not perceive some of the meat polish "produced by Keeley" on the reference collection that Keeley had made and Dumont used. (Dumont 1985: 469) It is impossible to say whether this is a problem with Keeley's or Dumont's work.

A further problem encountered with Dumont's work is his 'hide-working with haematite activity'. Although there is ethnographic evidence for this, and sound explanations as to why ochre should be used with hide, the evidence from Dumont's microwear would if anything suggest that whatever was done with the haematite, it was not done with hide. Only one artifact had both haematite deposits and 'hide polish' along the same working edge. (Dumont 1985: 415) As Dumont states:

"If hide regularly was worked in the intimate presence of haematite there is no obvious reason why the hide polish should have a different deposition from that of the haematite deposits" (Dumont 1985: 415)

All we have here is that haematite is present on the tools. Woodman, the excavator of Mt Sandel, already knew that, he classified the tools as "ochre stained blades". While the case for haematite and hide remains plausible, Dumont has not demonstrated that haematite was used to work hide in prehistory.

It can be suggested from the preceding discussion that data is currently inadequately presented as "Microwear analysis is far from reaching the status of a discipline like pollen analysis" (Newcomer *et al* 1986: 204)). The description of polishes by "type" predetermines interpretation, limiting the use of data. Finally, observations are often interpreted both over-confidently and with a high degree of untenable specificity.

6. An alternative approach to functional analysis

The problems outlined here concerning functional analysis, made worse by the nature of the raw materials used in this study, have caused a different line of approach to be taken from those now commonly in use. The methodology will be covered in the appropriate section, but in theoretical terms the method developed is neither "Low" nor "High" powered, but uses gross tool morphology, edge shape, overall location of traces, micro-topographical location of traces, and analysis of edge damage and polish (cf Newcomer *et al* 1986: 216). In addition, information derived from other sources, for example, environmental and ethnographical, can help to establish some parameters of potential use. This is the approach adopted by Unger-Hamilton (1985). The method here does differ in that it is in principle low powered in its *interpretative* phase, deliberately not trying to stretch the data beyond its potential. In essence it starts with the most basic interpretation possible, "was a tool used ?", and is developed from that starting point. However it does not attempt to go to any high level of interpretation, unless a) the evidence clearly supports the interpretation, b) the length of time taken to reach that interpretation is not excessive, and c) there is a purpose to such a level of interpretation. This method is not what most archaeologists expect of functional analysis but is of greater value than over-precise descriptions of a few isolated tool uses.

"Low Level Interpretation":

In this study great care has been made to separate the descriptive and interpretative phases of analysis. In addition the evidence is used in a different manner from most previous analyses. Unlike most of the "High Power" approach, and indeed, unlike much of the "Low Power" approach to functional analysis (cf Odell's "specific information" Odell 1977: 90), the target of the investigation has not been to produce detailed descriptions of exactly how and on what a tool has been used. That style

of work can be described as using a "High Level" of interpretation. In contrast this study uses a "Low Level" of interpretation.

The basic principle of this low level interpretation is to ensure that the interpretation does not exceed the information produced from the various sources of evidence used. Indeed, it is believed that some useful information can be gained from the evidence with only the minimum of interpretation. It is expected that only rarely, if ever, will it be possible to assign the precise function of a tool and the worked material it was used on.

The lower level of interpretation provided is not in itself useless. As stated above it is not what the majority of archaeologists expect from functional analysis. The expectations of archaeology have been raised by the studies already produced using a high level of interpretation. However at the same time that expectations have been raised, the whole reliability of the technique has been cast into doubt. Analysis of sites giving very detailed interpretations have been made, a classic case being the analysis of the Meer II assemblage, yet, as can be seen from the debate provoked by this study (Cahen *et al* 1979), the results are extremely problematic, particularly considering the matrix in which the tools were found, apparently part of a sand quarry (Cahen *et al* 1979: 662). Sand is likely to cause post-depositional traces that can confuse any use-wear traces, if it does not obliterate them completely with "sand sheen". Even if we do not assume that post-depositional features may be a problem, sand incorporated during tool use would be likely to seriously affect the traces of that work (Kamminga 1979: 152). Suggestions that 'becks' were used by a left handed person to bore bone (Cahen *et al* 1979: 666) are, as with Buller's 1983 work mentioned above, apparently pushing the evidence too far. Once again no primary evidence is provided. A later examination of the artifacts from Meer in conjunction with research into post-depositional wear traces suggested that such traces might have been mistaken for use-wear (Sala 1986: 108). (In defence of the paper it is a deliberately provocative attempt to extract the maximum information from a "poor site".)

The results of a recent series of blind tests (Newcomer *et al* 1986), and even those of the Keeley-Newcomer test when critically examined, cast

further doubt on many of the findings of the high level of interpretation. This has not done the sub-discipline of stone tool functional analysis any good. Archaeologists expect a high level of interpretation, yet many (especially other functional analysts) cannot believe a large proportion of such work. Another problem with the high level of interpretation of the "high power" method is the small and meaningless size of some studies.

The Benefits of Low Level Interpretation:

A low level of interpretation is therefore not what is expected of functional analysis. Yet, given the problems of the high level of interpretation, such a low level has much to offer.

- 1) It is relatively fast, and therefore relatively economical in terms of time.
 - 2) It can be used to examine a reasonably large sample.
 - 3) As it is not so sensitive to one form of evidence (polish or edge damage) it does not have to discount large numbers of tools due to poorly developed evidence, or the obscuring of that evidence by subsequent events (post-depositional damage).
 - 4) It is not based upon the use of a small number of tools with clear wear traces (and note Bordes warning to Semenov; using a spanner to hit a nail does not make it a hammer, even though the traces left may be clearer than from using it as a spanner (Bordes 1967: 25)).
 - 5) It is, within its level of interpretation, more likely to be accurate, and therefore supply less erroneous information, than a high level of interpretation.
 - 6) It allows the study of a large number of tool raw materials not suitable for a high level of interpretation.
-
- 1) **Speed:** There are two reasons for improved speed; the method developed, and the recording system used.

Although this method does require the use of high powered magnification, it is faster than a method based upon polish identification as very detailed analysis of polish is not attempted. This has to be compared with Dumont's problems caused by small sample sizes, including his explanation as to why the use of cores as wedges was only noted at Star Carr:

"its absence at Mount Sandel was probably due to the fact that no examples of the tool type responsible for this activity at Star Carr (re-used cores) were examined at Mount Sandel." (Dumont 1985: 445)

In fact the only thing that can be said is that the sample was too small to tell whether this usage occurred or not.

The multiple-choice recording system devised and described in detail below also allowed a speeding up of the analysis of artefacts.

2, 3 and 4) Sample size: The speed allows a larger sample to be studied within the time and cost restrictions common to most archaeological projects. This means that the results can be far more relevant to the site. Too many high powered approaches to analysis concentrate on the (frequently small) number of pieces that are suitable for the high level of interpretation. These samples are too small for statistical analysis, and are biased by their concentration on the pieces with the most developed traces. There is a danger that too many functional analyses are being done for the sake of the functional analysis rather than for their relevance to archaeological interpretation. The sample size is further increased because this current method does not have to discount many pieces as not being suitable for the analysis due to few or weak wear traces.

As examples of sample sizes examined with the "high power" method the following samples are among the larger samples so far examined. From Keeley, 248 from the Clacton Golf Course site (Keeley 1980: 87), 333 from Hoxne (ibid 127), Vaughan, 532 from Cassegros (Vaughan 1985: 57) and Moss, 129 from Pincevent, (Moss 1983: 108) and 475 from Pont d'Ambon (ibid 145), Vaenget Nord, 259 (Jensen and Brinch-Peterson 1985: 45), Mount Sandel, 273 artefacts out of 1355 formal tools and 42,838 'waste', Star Carr, 189 artefacts out of 16,937 (Dumont 1985: 58)

and Arjoune, 470 (Unger-Hamilton 1985). These samples may appear quite large, but they must be considered as amongst the largest samples so far examined. In addition their actual usefulness in general archaeological terms must also be considered. From Clacton a total of only 49 used and probably used pieces (Keeley 1980: 87), from Hoxne 33 with "traces of microwear" (Keeley 1980: 127). Cook and Dumont suggest that from these figures it is probable that of the 38,000 bifaces in Roe's 1968 gazetteer, "less than 1% are in a condition for microscopic examination" (Cook and Dumont 1987: 57). Only a few of these pieces may have wear-traces. There is a higher proportion from Cassegros, 158 flints with interpretable use-wear traces giving 283 "Independent Use Zones" (Vaughan 1985: 57). From Vaenget Nord, 23% of pieces were used, the low figure here being explained by the inclusion of microblades, broken pieces and small fragments in the sample (Jensen and Brinch-Peterson 1985: 45). Unger-Hamilton states that she could "only come to an opinion about 180 tools" (Unger-Hamilton 1985: 133), and this from a sample that emphasised formal 'tools' where use proportions would be expected to be high. These samples are very small in proportion to many stone tool assemblages.

5) Accuracy: As this method is based upon a cautious and limited approach, its levels of innaccuracy are likely to be less significant than those of a high level of interpretation. While results such as "6 tools used to saw wood, two to grave antler," etc., are unlikely to be produced by the method developed here, as matters stand the interpretations of use produced by a high level of interpretation are quite likely to be wrong. Being wrong in this case is worse than not producing results, as this may well cause a misinterpretation of the activities occurring on a site.

6) Raw Material: As this method is not geared to dealing with the neat features of wear found on "good quality" materials, such as obsidian and good quality flint, it is better able to deal with some of the poorer quality materials found over a large part of the world. The two case studies here of the Scottish Mesolithic chert tools and the Cypriot Chalcolithic chert tools are examples of this.

Purposes of the low level of interpretation:

The method developed here was designed to deal with some of the technical problems perceived in previous studies. Equally importantly, it was developed with specific regard to its applicability to archaeological data.

The interest generated in Keeley's use of polish identification was largely the result of his claim that specific worked materials produced specific *diagnostic* polishes. Nearly all the interest in functional analysis has since concentrated on this determination of specific worked materials. This has been done, to a great extent, to the detriment of broader concerns. Cook and Dumont ask:

"What the microwear analyst records from each artefact are the traces left by single historical events, each with unique characteristics which must be interpreted by reference to experimental material. This fact and the small size of the majority of samples prompts the question of whether microwear analysis can achieve an appropriate level of generality to be of use in developing our understanding of material culture and in promoting economic and behavioural studies, or whether it simply provides fascinating glimpses of some precise moments in the past." (Cook and Dumont 1987: 57)

Cook and Dumont's answer to their question is apparently favourable. They believe that many analysts have "judiciously transformed data from individual samples to make valid generalisations" (Cook and Dumont 1987: 59). This opinion is over-optimistic, and the implied methodology unsound.

It has already been stated that some studies have a clearly defined research aim, (eg "sickle blade" studies Anderson Gerfaud 1983; Unger-Hamilton 1983) whereas many other functional studies have only inexplicit general purposes. This is a direct consequence of the suitability of the method employed. It is important in the study of sickles to know whether a tool has, for example, been used on cereals or reeds, for agriculture or construction work. The polish identification method is clearly appropriate here, and indeed may be more reliable in this case, where the range of uses is apparently narrow, the polishes well developed, and the number of external variables perhaps more easily

quantified than in a more general study. It is not clear that the HP method is suitable for the more general cases on which it has more frequently been used. The speed of the method and the quality of the evidence required result in small samples, particularly when with reference to the number of apparently used pieces examined. The questionable nature of the very specific information produced, when added to sample problems, means that the identification of individual tool functions may be meaningless in terms of site activities.

The method developed here is designed to combat these problems. It is designed as a self-limiting process, where analysis is taken step by step. The description of the data is deliberately kept as simple as possible to allow re-analysis of the material, either in the light of developing patterns or problems during the course of the study, or at a later date, when for one reason or another it may be desirable to reconsider the information. By keeping this description of data simple it is hoped that subjectivity is reduced and that other researchers may have some hope of being able to re-use the data. For that reason and also for the sound methodological ones mentioned above, features are described by attributes, rather than as types. (A further reason, as will be seen in the section on the experiments, is a serious problem perceived with Keeley's high level of correlation of polish types.)

Once the data is collected it is treated very much as normal archaeological data. That is to say, as part of a puzzle, where no individual element can be trusted, or used by itself, but each has to make sense within the broader picture. As such the diagnosis of the precise function of a small number of tools is unimportant, or at least in the first instance, until the importance and relationships of those tools within a larger sample has been established.

Having established these broad principles it is possible to consider some of the ways that the data gathered may be useful. If the effects of some of the basic difficulties (eg the interference of post-depositional effects) can be minimised, it becomes possible to approach problems that may be interesting.

The first step that can be made is to consider what proportion of tools have been utilised. Given the typological classification of the sample,

does this proportion vary between classes? (The sample should not be initially biased in favour of formal tool types, pieces with readily visible edge damage, or even regular elements of the debitage. Such biasing, although perhaps necessary with a small sample, reduces the validity of this type of analysis.) From here we can progress to examine variability within classes, matching patterns across classes, range of variation and spatial and chronological variation. Further questions can be asked. Were tools used until exhausted, or only for a short time? Is this pattern of tool use uniform within tool classes? Is it different on different classes of tool? Do tools made of different raw materials have the same patterns of use-wear?

All of the above can be answered without trying to ascribe *precise* functions to the tools. Indeed it is not believed that the assignation of such functions is desirable at this point, as such work will by its very nature reduce sample size, and put its emphasis on the more dramatic aspects of functional analysis. It is believed that in attempting to answer these questions it is possible to produce far more useful information than whether one Mesolithic individual was left handed or not.

It is of course possible to broaden the scope of the study and to look at the variability with other sites, without becoming any more specific about individual tool function. It is again for such a purpose that the simple attribute recording is useful, as it allows other researchers to easily compare their data, not their final interpretation.

Only when the maximum possible information has been extracted from these patterns of wear-traces should inferences concerning precise tool function be made. Only those pieces with sufficient evidence for such inference should be analysed. At this stage it should be possible to ascertain whether these tools fit with the general patterns of use, or are isolated, non-representative pieces.

The temptation to define a site's economy from a few tools must be resisted. The importance of stone tools was almost certainly less to the users of those tools than to archaeologists. The organic (and now normally lost) component may have been far more significant. In his study of Ingalik material culture Osgood listed 339 items used. Of these only 16 incorporate stone, and this includes hammerstones, anvil stones

and amulets. The most commonly occurring item is spruce (incorporated in some form, including roots and wood, in about 50% of the items), closely followed by various caribou products (eg sinew, hide and bone). Bone is incorporated in 50% more items than stone. (Osgood 1940)

These statistics sound a cautionary note to the lithic analyst. Possibly the only consolation to a functional analyst is that he is not the only archaeologist to suffer from this problem. The formal typologist has a similar problem. Osgood describes the manner in which the Ingalik make things:

"you pick up some pieces, shape them a little, and tie them together" (Osgood 1940: 436)

Although much of the above may appear simplistic and self-explanatory, it appears that functional analysis must go back to basics. The problems with use-wear analysis are too serious for analysts to continue to provide highly elaborate reconstructions without at least presenting their data in such a manner that the reconstruction can be assessed.

7: The Experimental Programme and its Results

To develop an understanding of wear traces and the method of analysis, two broad categories of experiment were conducted. One was designed to be "realistic" and attempt to imitate prehistoric tool use and thereby allow the examination of prehistoric artefacts by analogy. The other was designed to test various hypotheses and was more rigorously controlled than the first.

Background to Experimentation

The current trend in functional analysis is to conduct "realistic" experiments. This trend, like so many in the field of microwear research, is based largely upon Keeley's work. Keeley believed that experimental use of tools should mimic prehistoric use as much as possible, down to the recommendation that use should take place in a "dirty" environment, rather than in an artificially clean laboratory (Keeley 1980: 15). This method in theory allows direct comparison with prehistoric tools, the assumption being that the experimental and prehistoric tools were used in a similar manner. It should therefore be possible to make analogies between the experimental tools and the prehistoric ones. There are however a number of basic problems with this approach. The first, and frequently forgotten, point to note is that such analysis is done by analogy. As has been shown above, it is not possible to give precise explanations as to how an individual trace has been created, our hypotheses of polish formation are still very primitive. There has been a trend over recent years for every experimental programme to exceed the last. The belief that further experimentation working more materials in different manners will solve our problems is misleading. There are an almost infinite number of possible variations in tool use, and it is impossible to replicate them all. Increases in understanding have occurred in a haphazard manner.

Knutsson argues that archaeological experiments are simulation rather than replication (Knutsson 1988). This is an important distinction.

Replication implies an accuracy in copying an actual event that is unlikely to be achieved. The aim of simulation experiments is not to replicate individual tasks, but to model the general processes of tool use, under conditions similar to prehistoric ones. Although this distinction may seem trivial, it is important, as there is a tendency to treat experimental evidence in a naive fashion.

Modern experiments are at the very least divorced from cultural aspects that may modify practical effects. Other more immediate matters affect experimental validity, such as the constant pausing in a task and the washing of the tool to allow timed examinations. No one would ever suggest that prehistoric peoples cleaned their tools in ultrasonic tanks at five minute intervals during a task, yet this is common practice in "realistic" experimentation.

While there are problems with the simulation approach to functional analysis, there are also problems with the strictly controlled "material science" based approach. It is very hard to design comprehensive experiments within the constraints of lithic materials. It is, of course, possible in an abstract manner to test the effects of one variable after another on stone edges and surfaces. However the range of individual variables is enormous, and they each inter-react in complex ways, so although the more controlled experiments may add useful information and greater *theoretical* understanding, the complete controlled experimental programme remains as effectively out of reach as the simulation of every prehistoric situation.

The experimental approach followed here attempted to strike a balance between the two possible approaches outlined above.

Simulation Experiments

Experimental work was designed to represent a practical way of conducting a task. During tool use the angle of tool, length of tool motion and pressure all varied to suit the progress of the task. A note was made at the end of each period of use to indicate the major angles of use. Although originally tools were examined at regular, 5 minute,

intervals during use, this pattern was changed. Some tools were examined at regular intervals, some at increasingly long intervals, and some at intervals determined by the tool or function. The last two patterns mean that a tool was examined when it was too blunt for further use, or when the task was finished. These particular experiments were regarded as very important, as only these last had really been used constantly for any length of time. It was considered that a tool used, for example, to cut hide for 20 minutes while being cleaned and examined at five minute intervals, was not "Used to cut hide for twenty minutes", but rather "Used to cut hide for four five minute periods". Differences in traces were frequently found between tools cleaned regularly and those used continuously. These differences could be explained by the "unreal" cleaning of tools.

Details of the recording system used are given in chapter 8. The details of each experiment are given in appendix A. A summary of the range of experiments is given in fig 7.1.

Fig 7.1

Experimental Programme		Worked Material												
Series	Total	Stone	Bone	Antler	Wood	Hide	Fish	Butcher	Plant	Missile	Shell	Pot	Misc	NUW
E###	143	5	15	4	39	22		24	12	4		2	2	14
TVC	61		6	6	5	12	2	3	2	2	1			22
RKC	38		3	11	2	8		1	2	5	1			5
LDC	18		4	3	2	3			1		1			4
BPF	26		3	5	1	4	1	2	2	2	1			3
GBB	16		2	4	1	2			1		1			3
ECF	36	2	4	7	10	4	1	2	1	2	2	1	1	4
CRC	41	5	5	7	10	6		1	2			2		5
GMC	29	4	2	2	5	3			2		1			7
New Series Total	265	11	29	45	36	42	4	9	13	11	8	3	1	53
Total	408	16	44	49	75	64	4	33	25	15	8	5	3	67

Variables

The following major variables were closely monitored during the experiments:

1) Raw Material:

The tool raw material appropriate to the archaeological material under study has to be used in experimentation. This does not necessarily mean finding the *precise* source used by the makers of the original tools, but does involve the use of materials that behave the same as the archaeological sample. Although some generalisations concerning the development of wear traces can be made, the fact that wear traces are to a large extent a function of the tool used means that different materials *do* produce different forms of wear. As far as possible, local raw materials were used in experimentation. The use of the chert from the Tweed for much of the experimentation for Smittons and Starr was considered acceptable, as, although petrologically not identical to the local material, experiments showed that it behaved in the same way and produced the same results within the resolution of this programme.

The raw materials used in the experimental programme were:

English chalk flint: typical black or grey chalk flint collected from Norfolk and Wiltshire. An initial series of experiments was conducted using this material (labelled the E### series). A second series labelled ECF was conducted in conjunction with the other materials studied. This acted as a form of control material, as this chalk flint is the most commonly used material in functional experiments. From this work comparisons with other studies could be made.

Beach pebble flint: Flint was collected from a number of sources on the West coast of Scotland, and from Islay. This material consists of small, rounded and battered pebbles. Internally it varies in colour, typically

either black/grey or brown. As a result of the battering received it is frequently internally shattered. Experiments conducted with this material were labelled BPF.

Chert from the Southern Uplands:

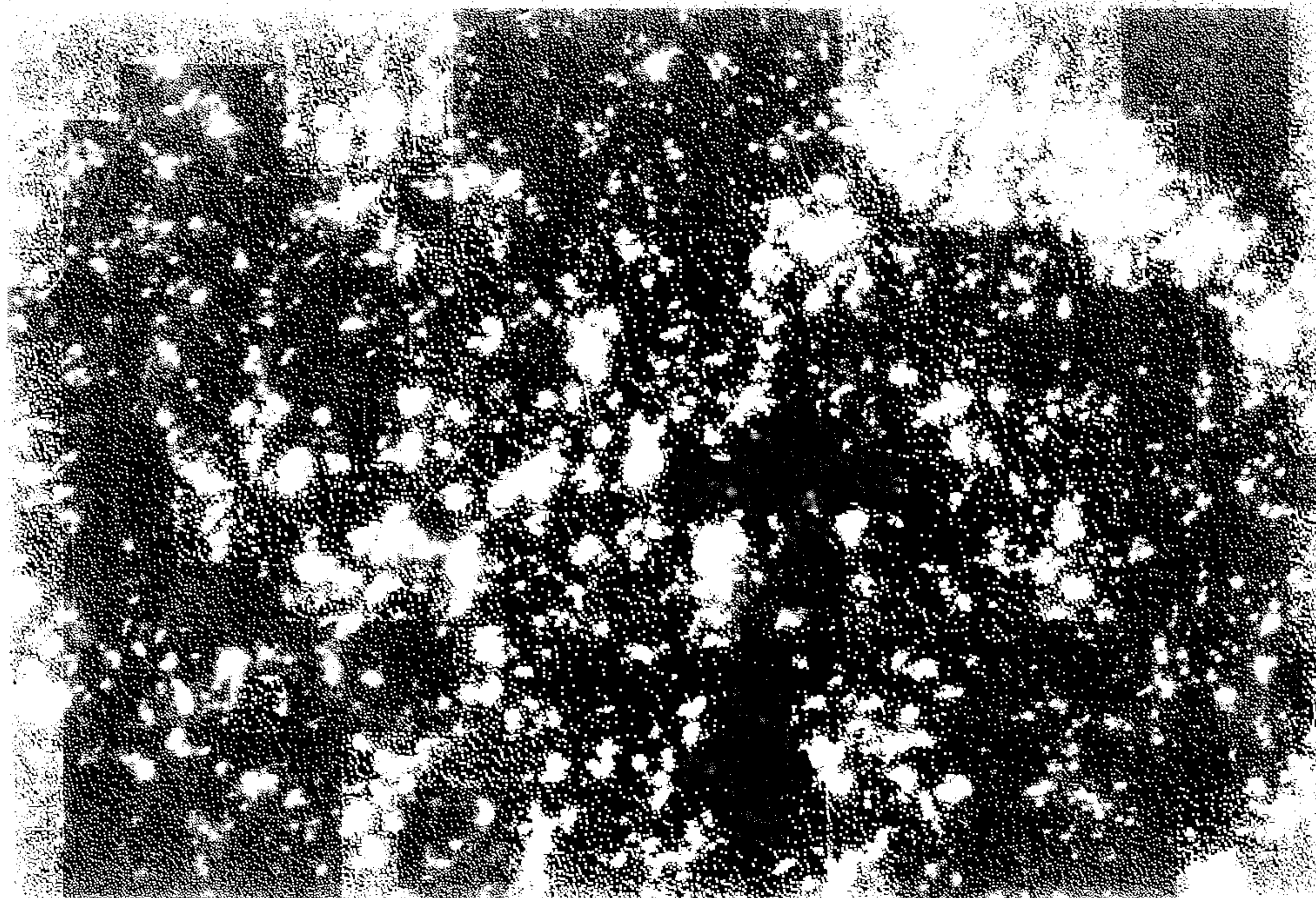
Loch Doon Chert: chert was collected near the site of Starr by the late Tom Afleck. The material supplied generally consisted of small angular pebbles. The colour of the material varied from black to pale grey. This series was labelled LDC.

River Ken Chert: chert was collected from the River Ken, near the site of Smittons, by the late Tom Afleck. This material consisted of small pebbles, generally partially rounded. It varied in colour from grey to dark brown. This series was labelled RKC.

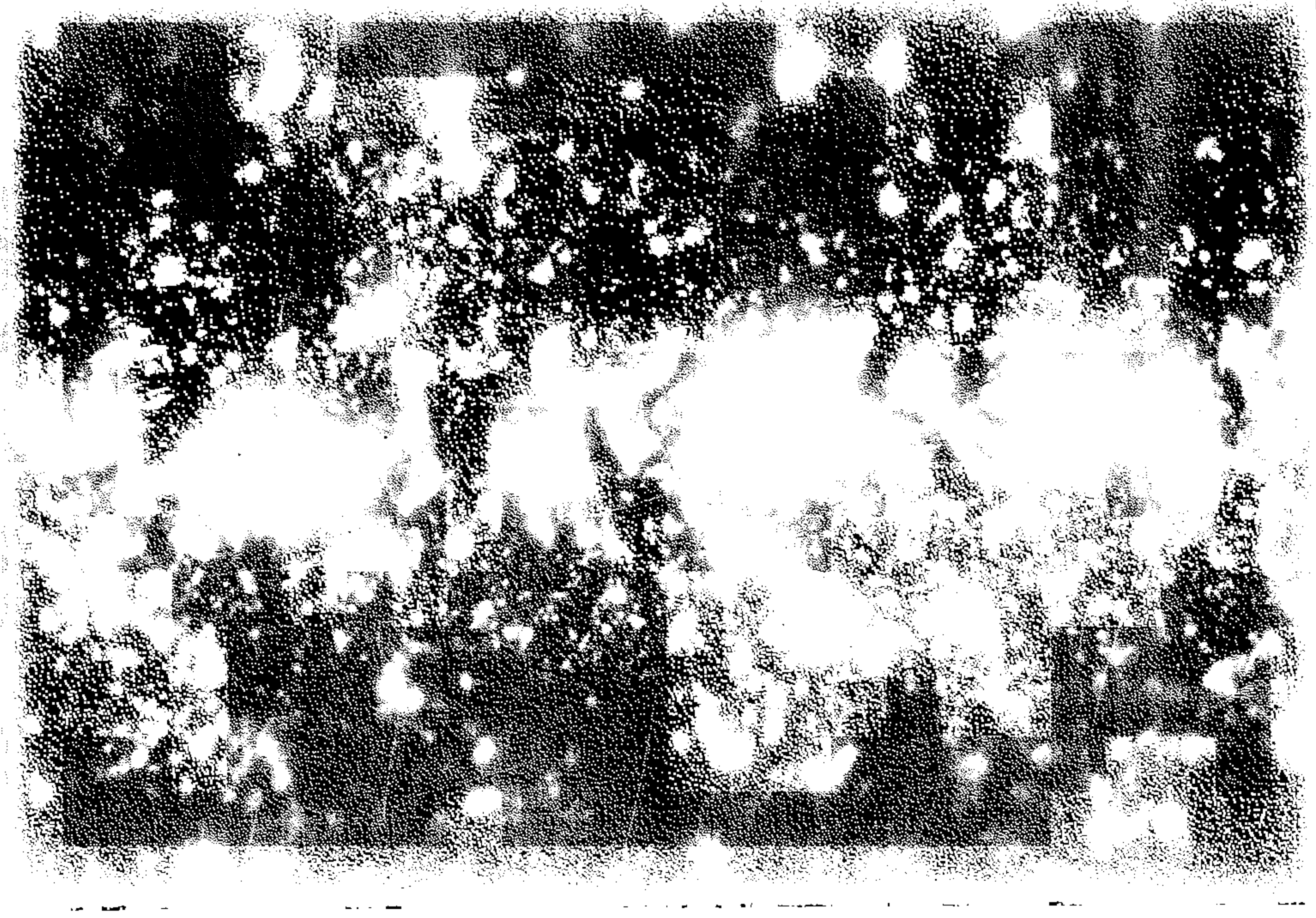
Tweed Valley Chert: material was collected from the Tweed valley by C. Wickham-Jones and the author. Large angular pebbles varying from black to grey, and with mottles of green, purple and brown were collected. The material was considerably fresher in appearance (and presumably more recently eroded) than much of the Dumfries and Galloway material. This series was labelled TVC.

All the Southern Uplands cherts are very similar in character, and vary so much *within* each area that it is hard to distinguish between sources. They behaved very similarly to one another in the experimental programme, and for the purposes of this study can be considered as a single raw material type. All the cherts vary in colour, and include black to pale grey shades, dark brown and purple. Some pieces have green mottling. There are also variations in texture, some of the material being very fine grained, while other material is very coarse, and tends to crumble. There are a variety of internal features present; most noticeable are the fault lines through the nodules. These lines are typically angled to one another so that the chert tends to break down to angular, rhomboid shaped chunks. This process can occur both naturally and during knapping. The percolation of water through these faults has resulted in the deposition of quartz in planes through the material. In addition recrystallisation of the material produces microscopic

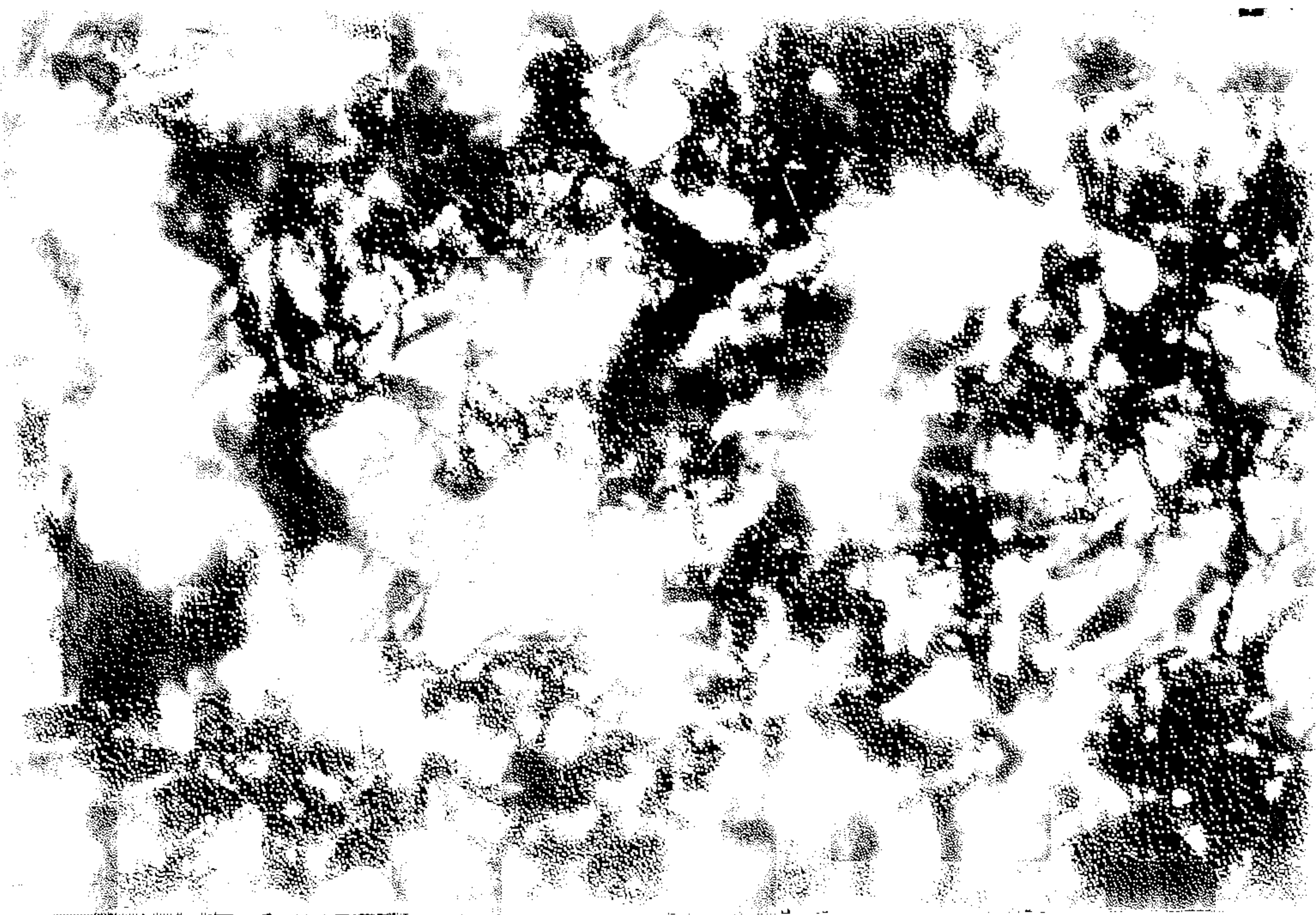
FLINT REGULAR SURFACE



CHERT IRREGULAR SURFACE



CHERT FLAW WITH QUARTZ CRYSTALS



CHERT ROUGH CRYSTAL SURFACE

variations in texture. (see plates) Where possible, fine-grained, inclusion-free material was selected for knapping. This material normally has a good conchoidal fracture, but the chert does have a tendency to splinter and to shatter, especially along fault lines. This process can occur during use as well as manufacture.

Bloodstone: Bloodstone was collected during the course of the Kinloch Farm excavations. Details of the source and material can be found in the site report (C.Wickham-Jones in press). In essence the material is a volcanic chalcedony, primarily "plasma". The term bloodstone is used for convenience to cover the whole range of materials. The material varies greatly in colour, with green shades dominating. Large quartz crystals are occasionally present, and spherulites of ferroan calcite are common, infilling vesicules in the material. In general the more homogeneous and inclusion-free pieces were selected for knapping. This material was labelled GBB.

Cypriot red chert: this material was collected during fieldwork to locate possible chert sources around the Lemba group of sites. The main source for the material used in this study was a secondary deposit at the mouth of the Mavrokolimbas river. The material is variable in texture, from a very fine homogeneous chert, generally dark red, to a very coarse, paler irregular material. Occasional blue/green inclusions are present. This material was labelled CRC.

Grey Mottled Chert: This material was collected at the same time as the CRC, and was found in the limestone hills behind the site. It is extremely variable, representing arrested stages in a chert development sequence. The material includes a soft, pale Opal-CT (cristobalite); a grey chert with brown inclusions; and a developed dense black chert. This last behaves like English chalk flint. All the nodules used in the experimental programme were collected from derived sources, as the *in situ* bands of the material located were too narrow to use (only a very short period was spent prospecting).

These cherts are highly variable, and consequently enable certain generalisations to be made concerning the development of wear patterns on different raw materials. As a result, it became clear how important differences in tool material are to trace development.

2) Tool type:

As different tools have varying suitability for differing tasks, and as the tool affects the traces produced, it is necessary to make replica tools for the purpose of simulating tool use. In particular, it is important that the working edge, and any other parts of the tool that come into contact with the worked material, should replicate the archaeological sample. One variable that was impossible to control was the variability of the chert. Although a tool morphologically the same, or similar, to an archaeological piece, could be made, it is impossible to control the variability within the stone. As this is of great importance in this study, internal flaws, recrystallisation features and textural variability were examined very closely in an attempt to study how they affected use-wear traces.

3) Worked material:

The various potential worked materials include the now standard "experimental use" list of wood, bone, antler, hide, meat and soft vegetable matter. In addition some other possible materials were included: stone, ceramics, fish and horn. Variations in the condition of these materials (fresh/seasoned, raw/cooked, dry/wet, etc) were tested.

4) Environment:

Most of these simulation tool uses were conducted in a "dirty" environment, allowing comparison with prehistoric tool use, although some "simulation" tool use was deliberately done in a "clean", laboratory environment. This was done for comparative purposes, to examine how important the working environment was. This "clean laboratory" use is

distinct from the controlled test experiments, as it still concerns "real" tool use.

5) Expertise:

Varying expertise in tool use has a significant effect on wear traces. A series of experiments with Brandon chalk flint were undertaken at the beginning of this project (the E### series). They comprised 122 tools with 143 different uses. This series was discarded as a learning series. It showed a marked change in the development patterns of wear traces from start to finish. There was also a marked increase in the efficiency of using similar tools to do similar functions over this period. This efficiency worked both in the improved achievement of tasks, and in less damage being done to the tools. Other experiments were conducted later on with each new raw material studied to allow the analyst to become accustomed to the material. Although people will always have had to learn how to use their tools, the archaeological record is unlikely to be dominated by such "apprentice" pieces. They were therefore discounted as being unrepresentative of the majority of tool use, although instructive in themselves.

6) Function:

As the purpose of this series was to simulate tool use, an attempt was made to use the tools in a purposeful manner. This of course varied for the different sets of experiments done, as some tasks (like the drilling of pot sherds) were only relevant to some contexts. An attempt was made to follow a task through, for example the production of a bone pin, or an antler needle. Obviously in such tasks it becomes less relevant to talk in terms of the limited categories of "task" established by Keeley - whittle, groove, plane, saw, cut, groove, chop - as during the process the precise category alters. Equally importantly, work has to be far more delicate and careful than in a notional "scrape bone for 20 minutes". While such experiments were done, it was felt that the finer working often was a more likely simulation.

Results and Conclusions:

The results of the experimental programme suggest that great care needs to be taken in the interpretation of wear traces. Different causes can produce very similar effects, although the precise combinations of traces, their location on the micro- and macro-topography of the tool, and the tool morphology, can normally eliminate many of the possible causes.

It became apparent during the course of the E### experiments, and even more so during the following series, that no *single* feature was a reliable indicator of use. In addition it became clear that the experiments were not producing evidence for distinct polish "types". Analysts from the Institute of Archaeology in London were able to support these conclusions, and had already begun to develop a multi-variate approach to use-wear. Further support for these conclusions came from the developing theoretical model of polish formation, which suggested that there was no reason why there should be a simple correlation between worked material and polish.

As a result a reappraisal of functional evidence was made. A new interpretative framework was designed that accounted for the variation in quality and reliability of the evidence. All the features commonly mentioned by use-wear analysts, edge-damage, polish, striations, edge angle and tool morphology were to be used, but no individual feature was given primacy. The interpretation of use was based upon how the features inter-reacted. The same task could produce different traces upon different tools, depending upon material and edge angle. The types of scar that develop are related to edge angle as well as task. Similarly polish development is influenced by tool macro-morphology and micro-morphology. A tool material with a coarse texture will not enable an allover smooth polish to develop as quickly (if at all) as a fine-grained material. The method of working will affect the pressure between tool surface and worked material surface. This means that a delicate task may produce traces that suggest that the material worked was softer than if the task had been more vigorous. It was noted during the experimental work that occasionally the traces on a piece could not

be properly explained. This last observation again suggests that great care has to be taken in the interpretation of traces on archaeological samples.

In the blind tests four levels of information have been analysed, area of use, motion of use, hardness of worked material, and specific worked material. The overall patterns of traces for each of these levels can be summarised as follows:

Area: Some traces may appear scattered on the tool, the results of accidental non-use-wear causes. Wear traces will tend to be more regular, associated with other traces. Normally wear traces will not appear randomly scattered around the tool, but concentrated on a particular portion. The location of these traces not only indicates which part of the tool was used, but may also provide some information as to *how* the tool was used. Certain functions can be eliminated depending on the shape of the used edge. At its simplest this means that traces on a burin facet, for example, are unlikely to be the result of cutting a soft material.

Motion:

Where present striations are a good indication of direction of tool motion. Unfortunately in the experimental sample striations were not common (Fig 7.2)

(Key to reliability figs: A = Absent, W = Wrong,
P = Partial and C = Correct)

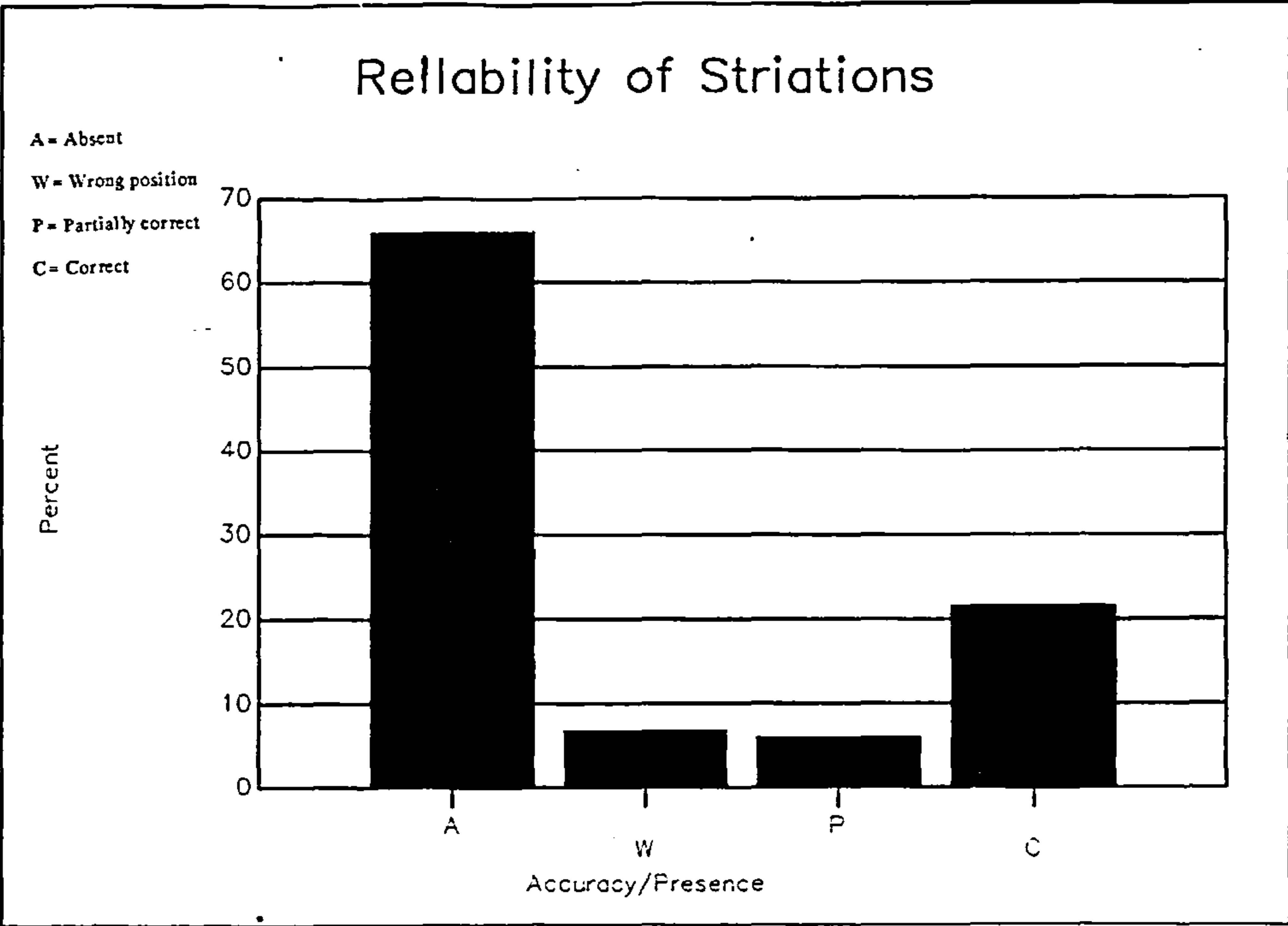


Fig 7.2

Edge damage is often a good indicator of motion. Transverse actions tend to produce unifacial edge damage, opposite the contact face, and longitudinal actions

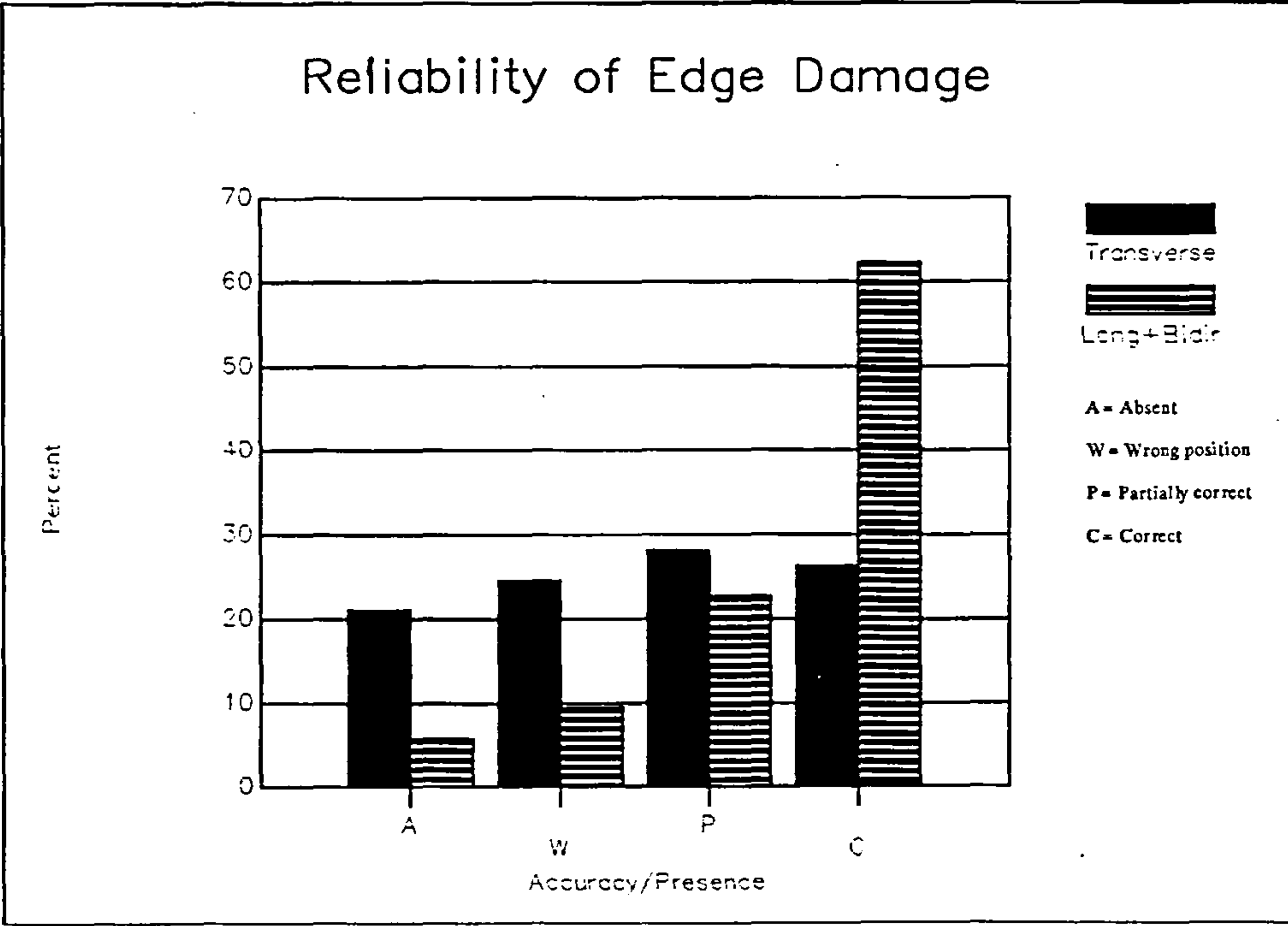


Fig 7.3

bifacial edge damage. Fig 7.3 shows that edge damage is a very reliable indicator for long motions, but less accurate (25% wrong or misleading), and frequently absent (21%) from transverse motions. There are two main reasons for this differential reliability. The first is that transverse working generally requires the use of greater edge angles than longitudinal working. This means that edges tend to be less prone to edge damage. The second is that tools used for transverse working tend to be more heavily retouched (often as scrapers) than tools used for longitudinal working. This means that edge damage is harder to observe as it can often be confused with retouch working. In some cases edge damage may indicate which longitudinal direction was involved, or even whether the tool was used bidirectionally. This information is derived from the direction of scars along the edge, and whether any scars are found on the arretes of previous removals (Fig 7.4).

Polish is a good direction indicator, either directly from linear polish features, or from the overall distribution of the polish. Polish distribution is also a good indication of the degree of penetration of the tool into the worked material, and the differential contact of the tool faces. Polish distribution for transverse actions tends to form on the contact face, the opposite to edge damage distribution. For longitudinal motions polish is the same as edge damage, and tends to form bifacially. Fig 7.5 shows that for longitudinal motions polish is approximately as reliable as edge damage. It is absent more than twice as often as edge damage, but is less likely to be wrong or misleading. It is substantially more reliable on transverse actions than edge damage, although there is still a very high error rate. It is present more reliably than edge damage.

Some pieces have wear traces that are opposed to the normal expected distribution. Tool CRC 35 has edge damage and polish both indicating a transverse action, and both in agreement about direction. Unfortunately the direction indicated is the wrong one. This type of error can be explained, in this case by the very low angle of working, and the depth of penetration into the material

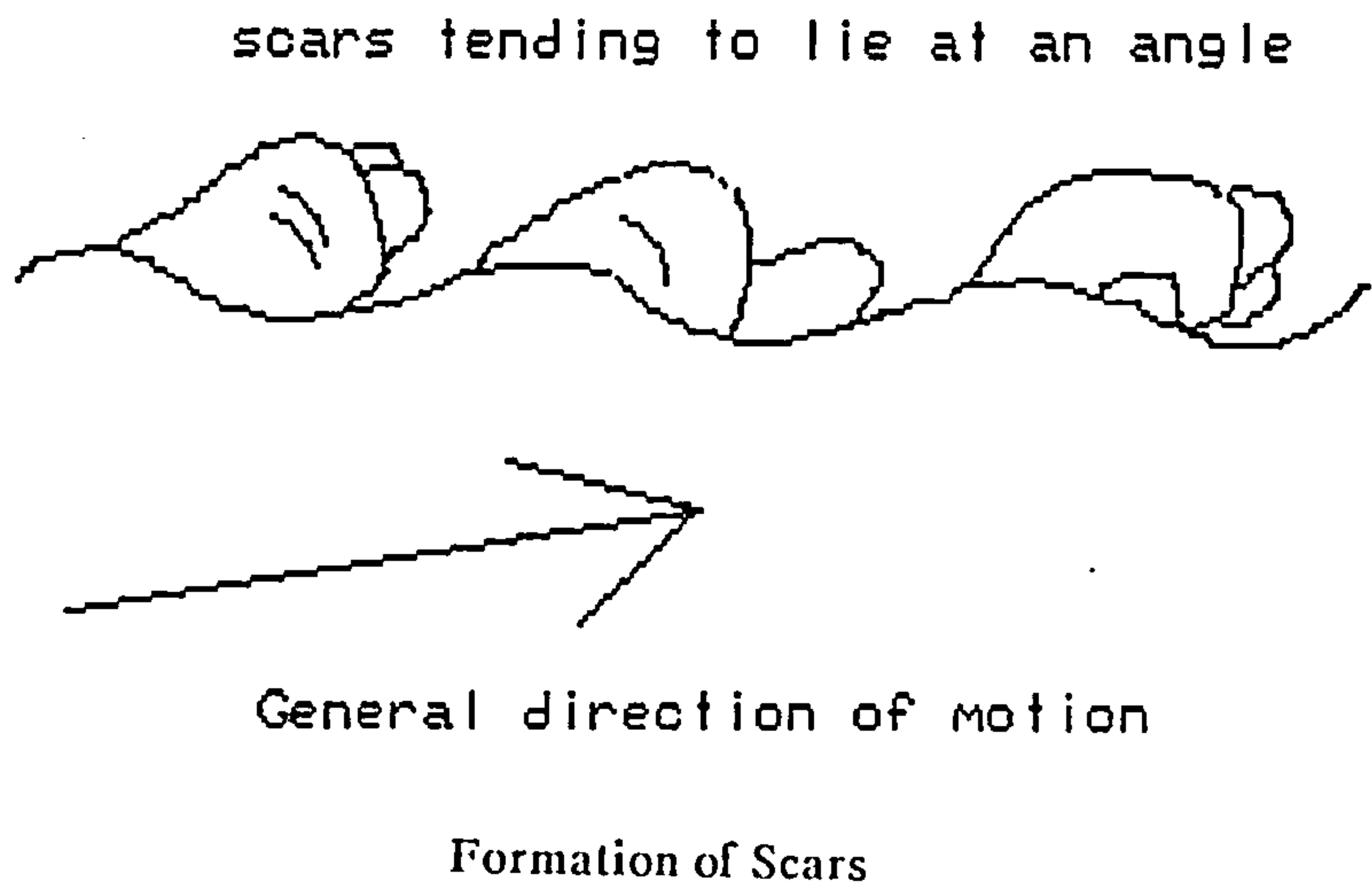


Fig 7.4

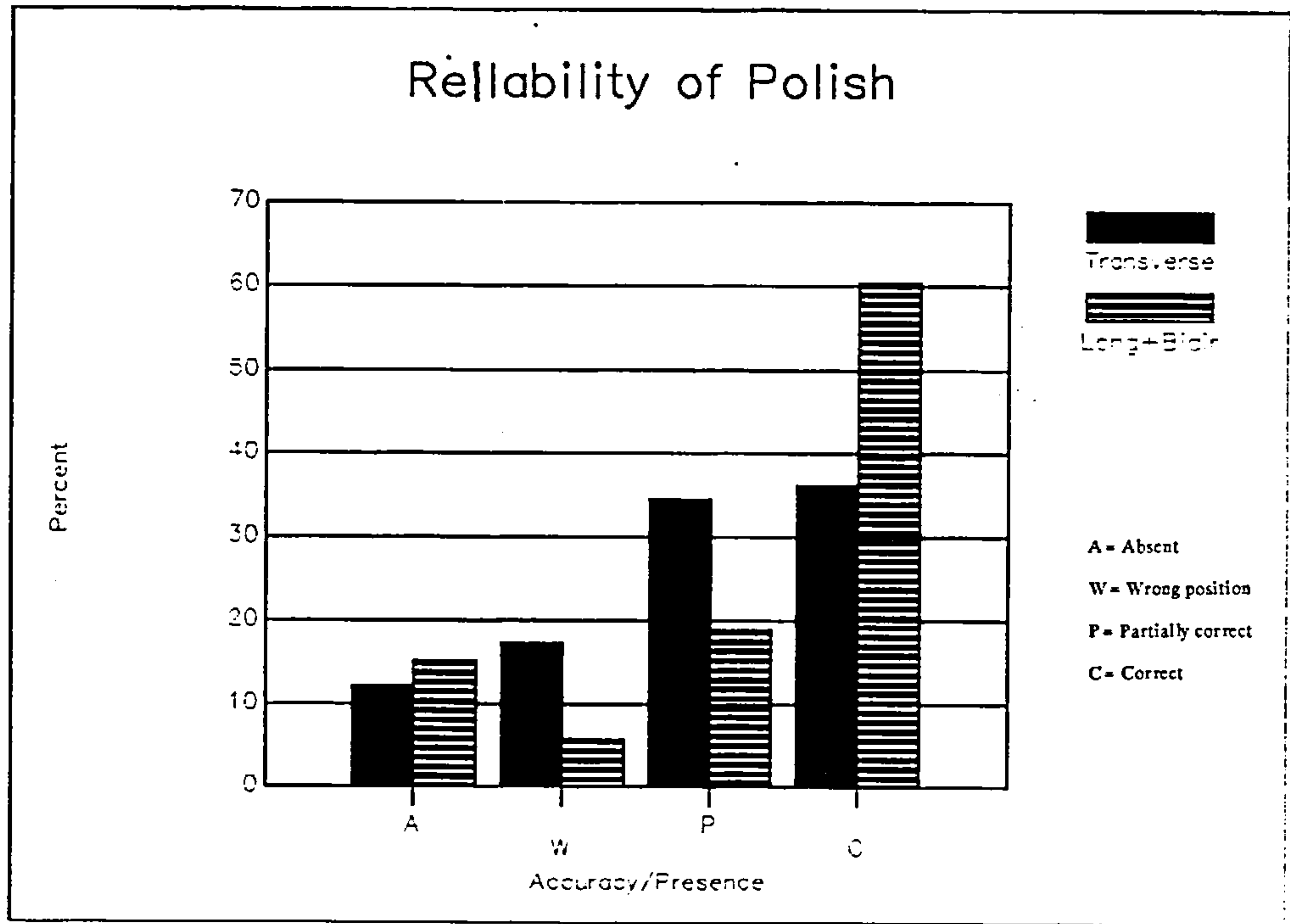
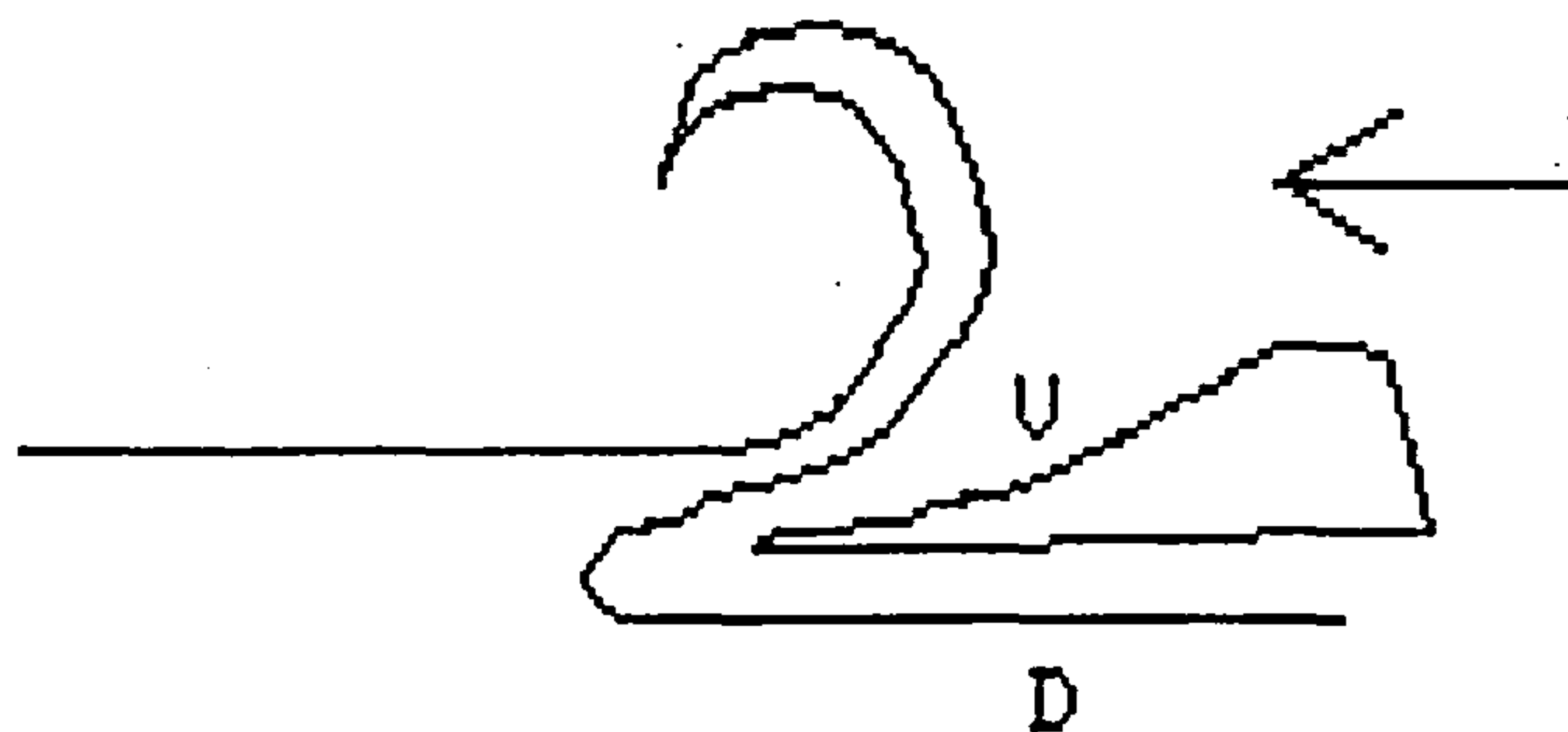


Fig 7.5

(Fig 7.6). However, such exceptional pieces pose a problem for the analysis of prehistoric samples. This can only be overcome by not placing too much emphasis on individual tools, but on large samples. Fortunately such cases of where both the edge damage and the polish are misleading are relatively rare.



very low angle of work and depth
of penetration produce atypical pressures

Fig 7.6

By comparing the two types of wear a far more reliable analysis can be made. The assessment of polish with edge damage tends to confirm analysis, or increases the number of pieces with traces, as the two types of evidence are not always found on the same pieces (Fig 7.7). Transverse motions still present more of a problem than longitudinal motions.

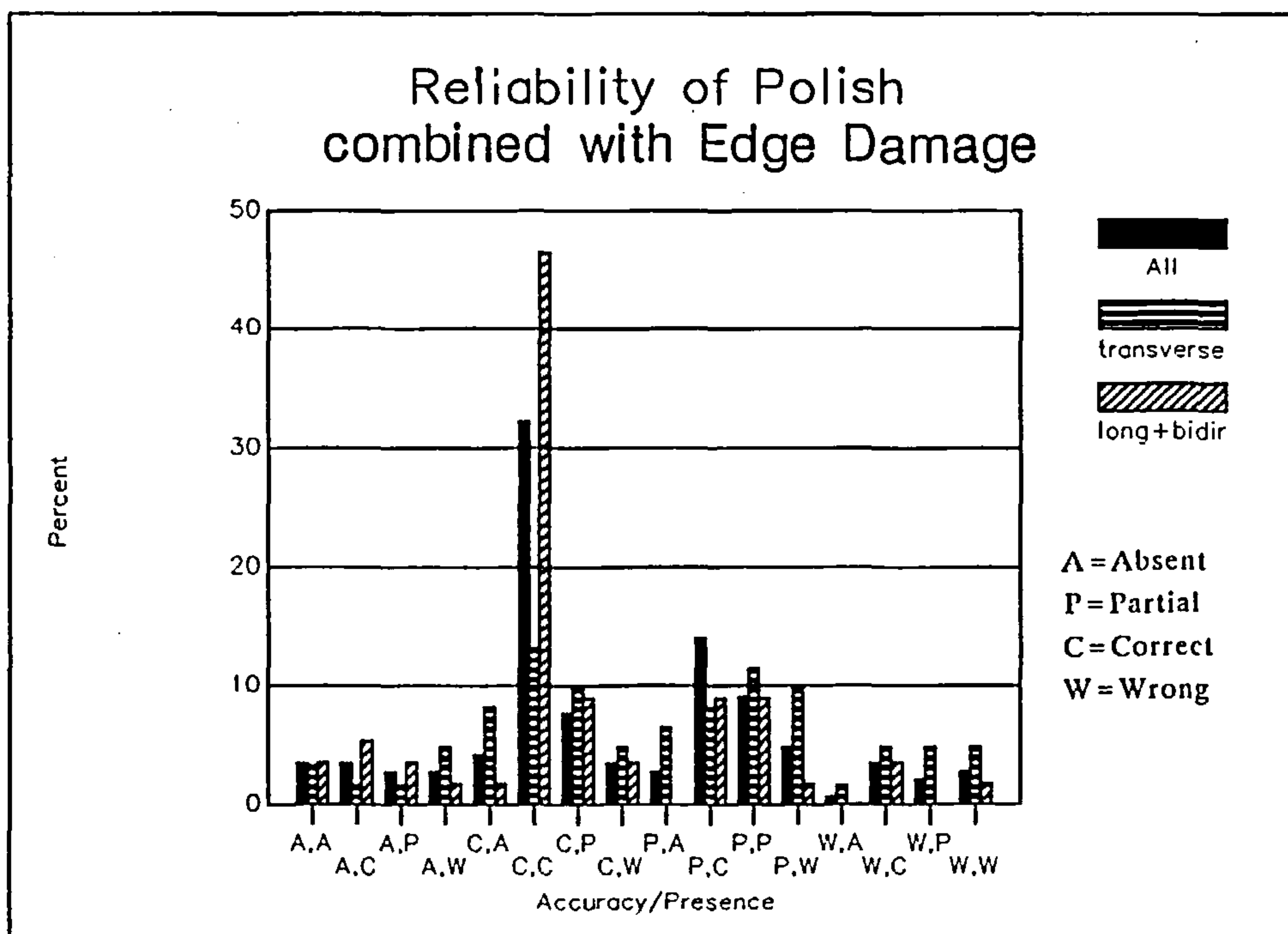


Fig 7.7

Combined Results; ie. A,A=both edge damage and polish Absent, C,C=both correct, C,P=one correct, the other partially correct.

By combining the evidence into five categories the picture becomes more simple. The categories are:

Correct: Pieces with correctly positioned traces, with either correct, partial or absent traces.

Partial: Pieces with partially correctly positioned traces, with partial or absent traces.

Conflicting: Pieces with incorrect or misleadingly positioned traces, with correct or partial traces.

Absent: Pieces with no traces.

Wrong: Pieces with incorrect or misleading traces, with wrong or absent traces.

Fig 7.8 shows the material examined in this way. There is an improvement in the level of correct identification, by only 5% from polish alone, but by 15% from edge damage alone. More importantly, the proportion of "wrong" or "absent" identifications is dramatically reduced. The number of pieces with "conflicting" evidence is large (25%), but this category is preferable to the "wrong" or "absent" groups, as it is normally clear that there is a conflict in the evidence.

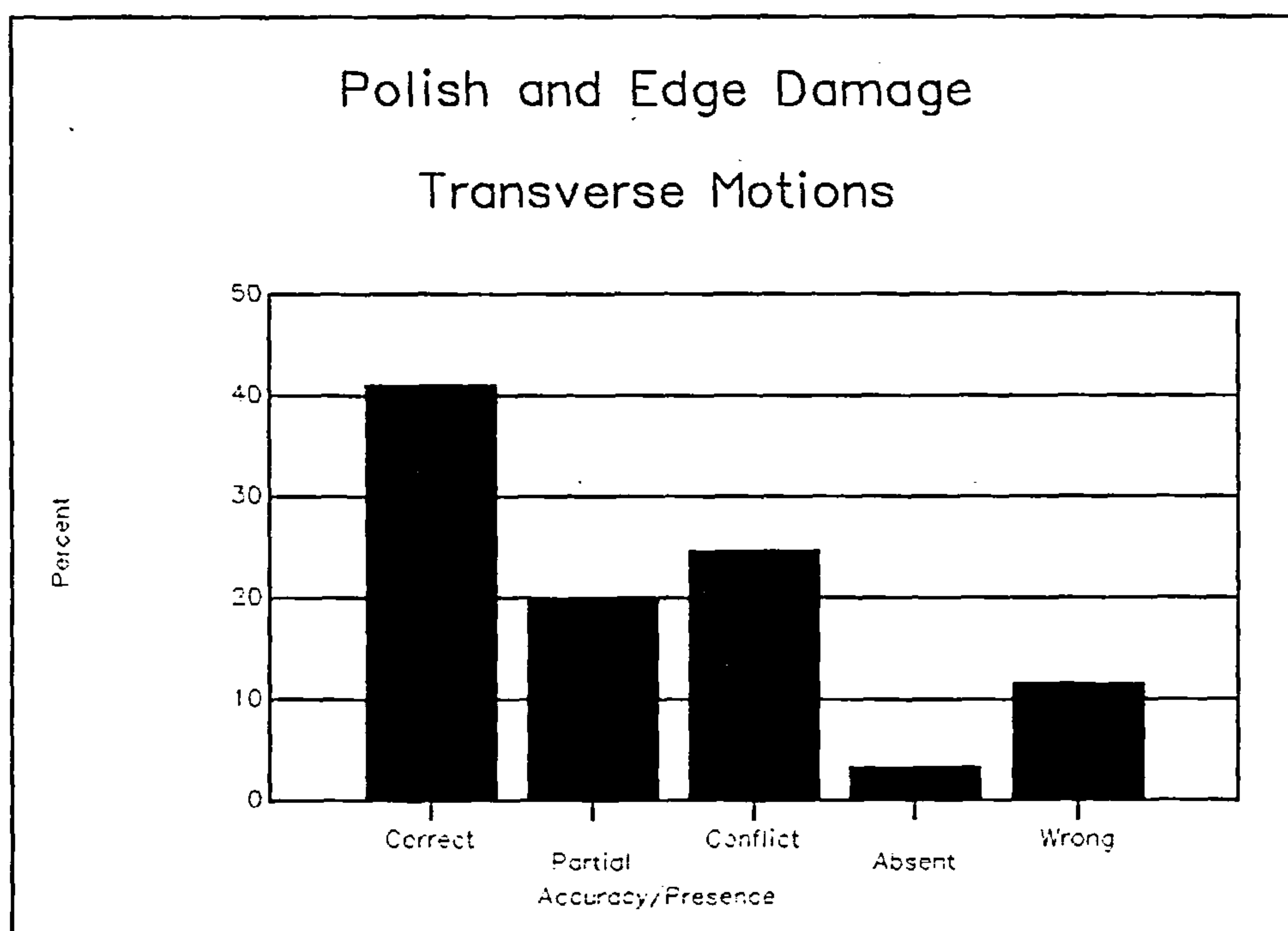
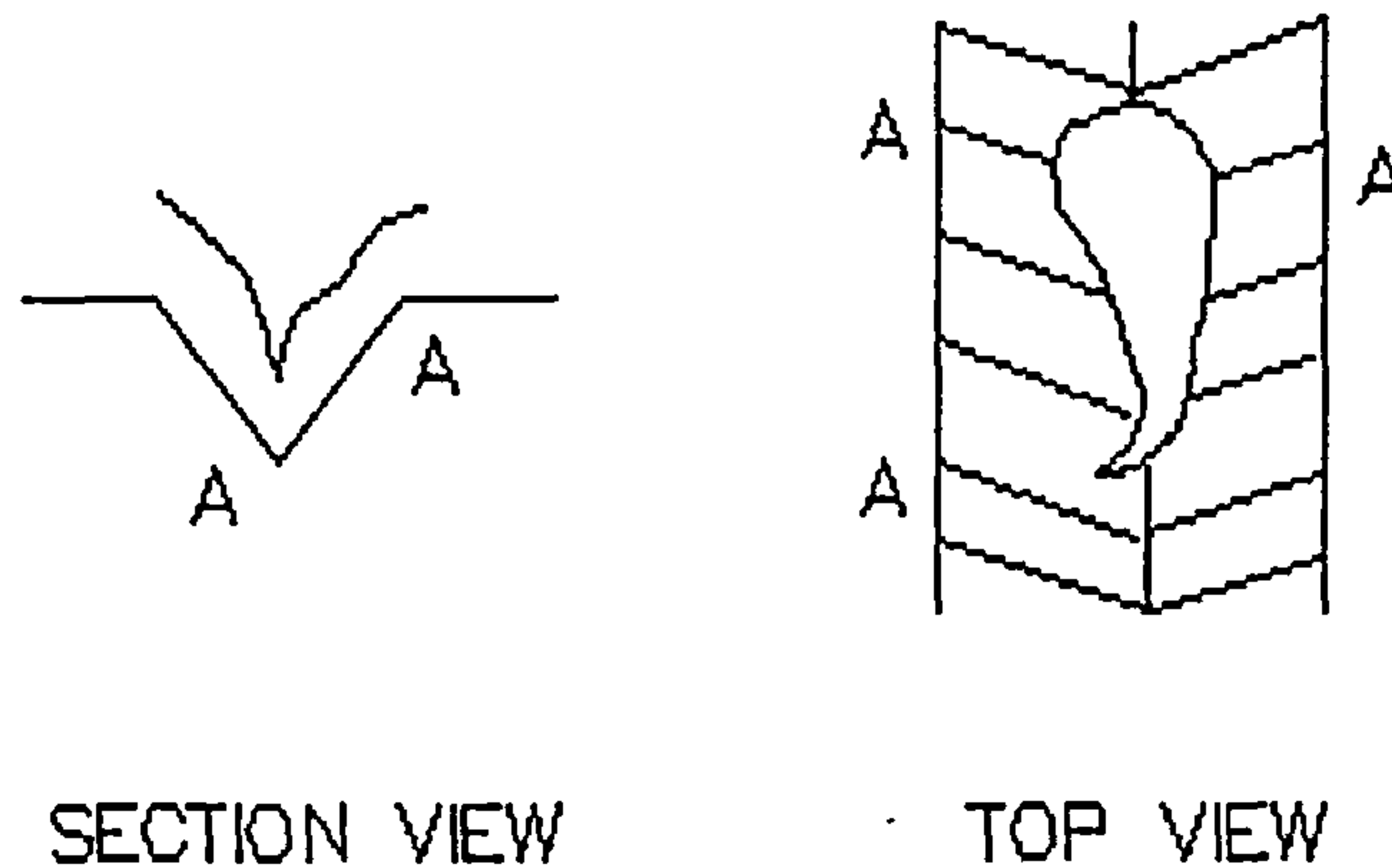


Fig 7.8

Combined Evidence

To support the evidence from trace location and direction, or to enable pieces with conflicting evidence to be analysed other features have to be taken into account. Edge morphology is important here. Tool edges are rarely symmetrical, and the differential shapes of the dorsal and ventral faces may increase localised



A = Areas of greatest pressure
with increased polish development

Model of Variable Pressure on Tool

Fig 7.9

pressure, thereby increasing polish development in specific areas (Fig 7.9). Precise details of motion may be found from such features as differential distribution of traces, "shadowing" of polished areas, or cutting of features by edge damage.

Material Hardness: Material hardness is for the purposes of this study considered to be the same as the property of yielding. The hardness of the worked material affects the traces produced. Hardness is a continuous variable, and the effects produced by different degrees of hardness and softness reflect this. As a result the traces indicate trends, rather than precise hardness. This is significant, as it is this aspect of wear traces that is most "material-specific", and has suggested to some that there may be polish "types", diagnostic of specific worked materials. On the contrary, hardness is only *related* to specific material. Any individual piece of a given material may vary in specific hardness as a

result of variables such as moisture content, freshness and age. Dumont (1988) noted that the condition of a material was extremely important, but then assumed that each specific material remained distinct regardless of its condition. In fact the different hardness of materials overlaps enormously, preventing reliable material-specific diagnosis (Fig 7.10). This fact may be obscured if only a narrow range of experiments is conducted, and if each material is constant in its condition. For example soaked antler will be fairly constant in hardness if always soaked for one week, but if "soaked antler" includes pieces soaked for one day or three weeks, the range of hardness is great.

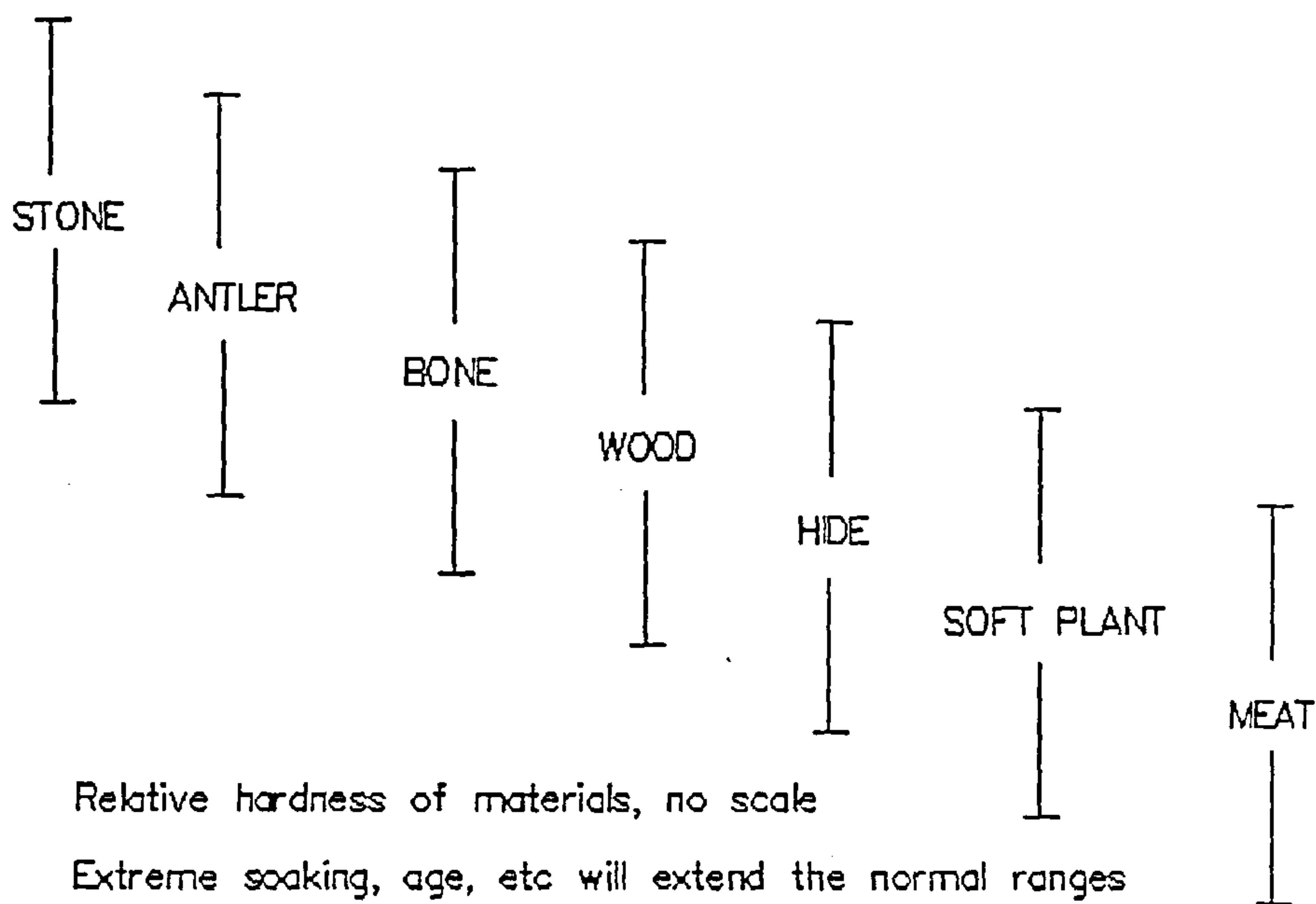


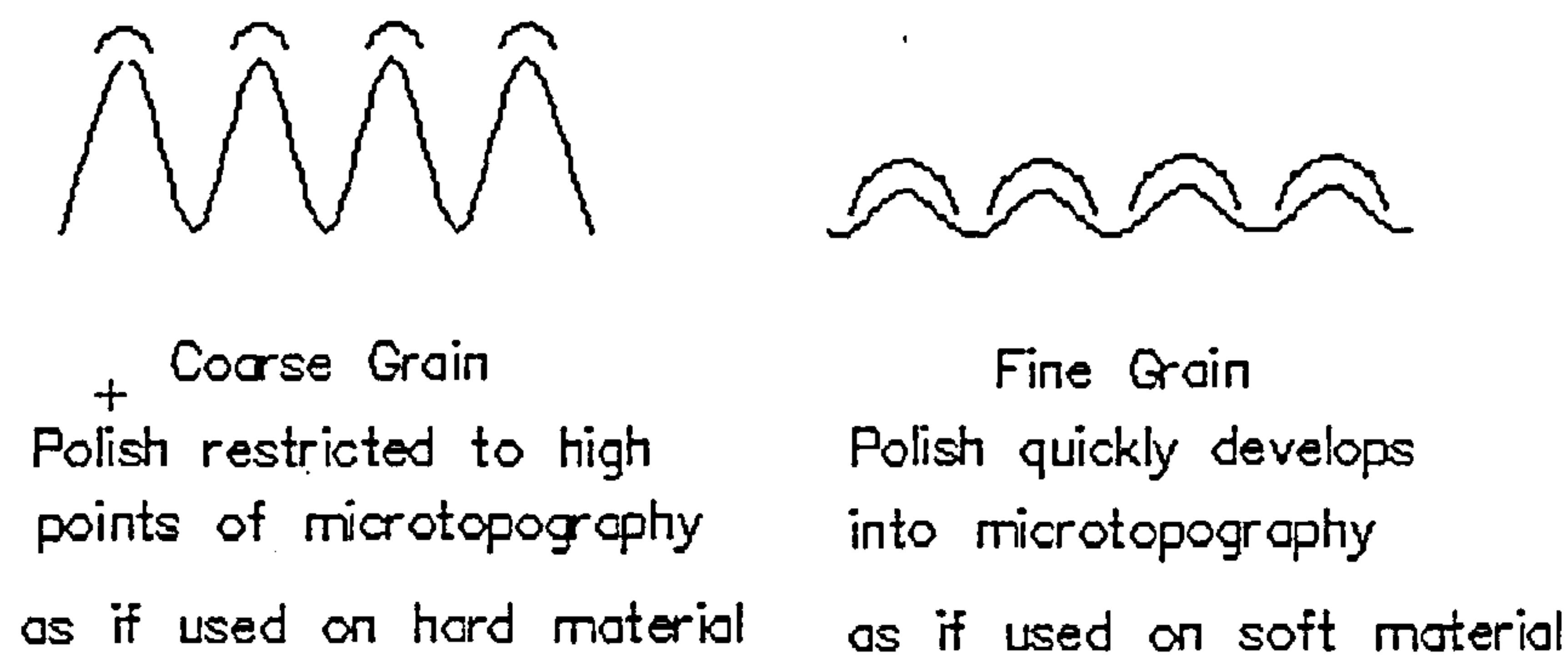
Fig 7.10 Model of overlapping worked material hardness

Having stated that hardness of material is a continuous variable, and that the resulting traces are continuous, the traces produced at the two ends of the spectrum can be summarised:

Hard Material: Edge damage will be dominated by step terminating scars, and will include snap fractures. Polish will be restricted to the high parts of the microtopography, either as isolated spots, or becoming reticulated.

Soft Material: Edge Damage will be dominated by feather terminating scars. Polish will be invasive into the microtopography of the tool, tending to be more continuous than above.

These are ideal situations. Because of the inter-relationship of hardness with tool material and time, the evidence is rarely so clear cut. The tool material texture influences the degree of penetration of the polish, so that a coarse grained material tends to have a polish distribution more indicative of a hard material, than a fine grained material (fig 7.11). Edge angle and direction of applied force influences the shape and



Variation in polish caused by different tool materials

Fig 7.11

termination of edge damage scars. The longer a task is conducted, the more the polish will tend to develop, becoming less scattered and more continuous over the surface of the tool. This means that the various tool attributes and trace types have to be considered together. If a tool has a polish that is invasive into the microtopography and continuous over the surface it is necessary to examine the edge angle and damage to determine worked material hardness. If it also has a thick, stable edge with much edge damage, including step terminations and snap fractures then the worked material is likely to have been very hard, and the duration of use long. If however the edge angle is low and the damage minor, consisting of a few feather terminating scars, then the worked material is likely to have been very soft.

In addition material hardness affects the reliability of traces. Taking the same four categories of accuracy as under motion, and dividing hardness into four rough categories (hard, med-hard, medium and medium to soft) it can be seen that the reliability of trace features is related to material.

Fig 7.12a shows that over 60% of the absent edge damage on transverse motions comes from the medium to soft category. This is not surprising. More

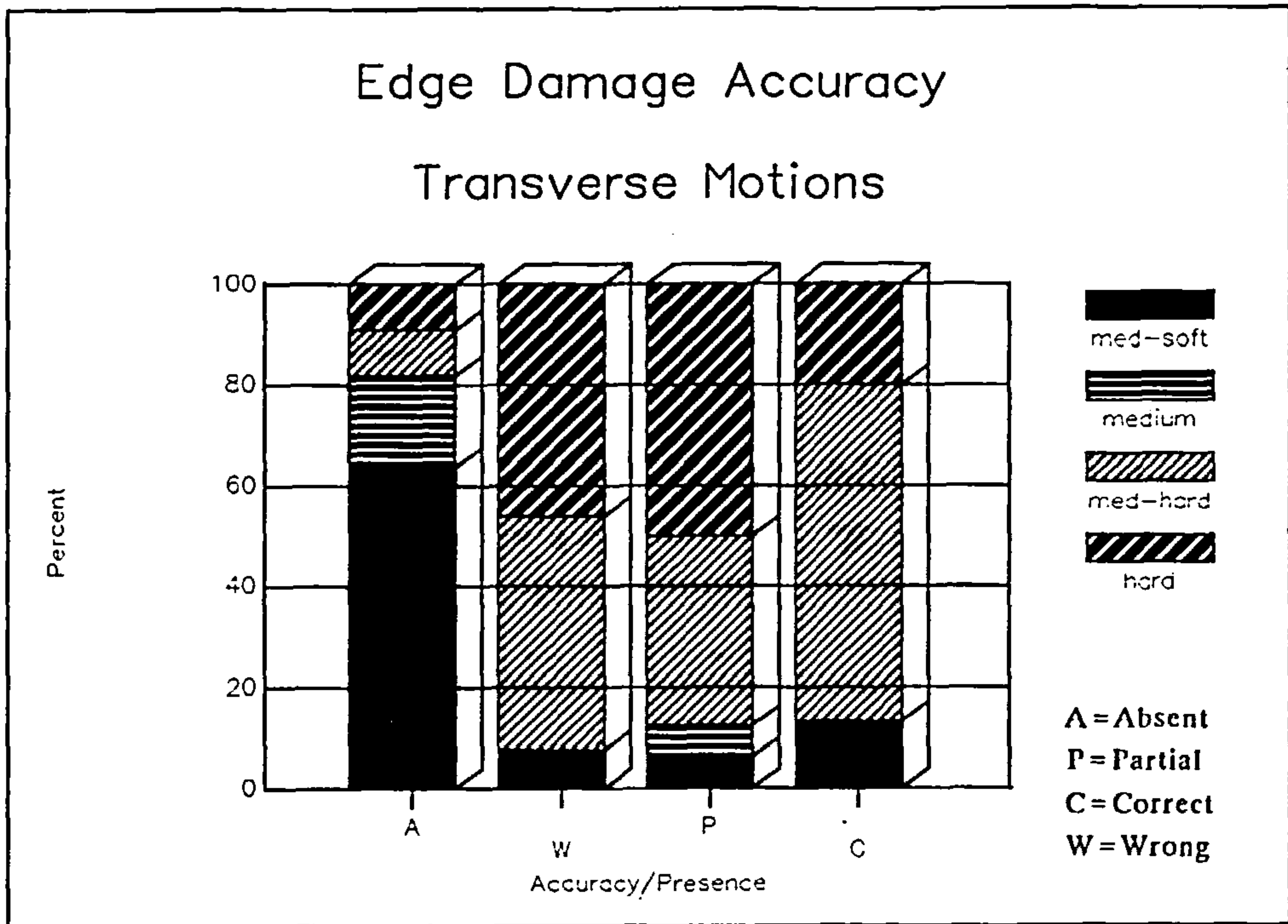


Fig 7.12a

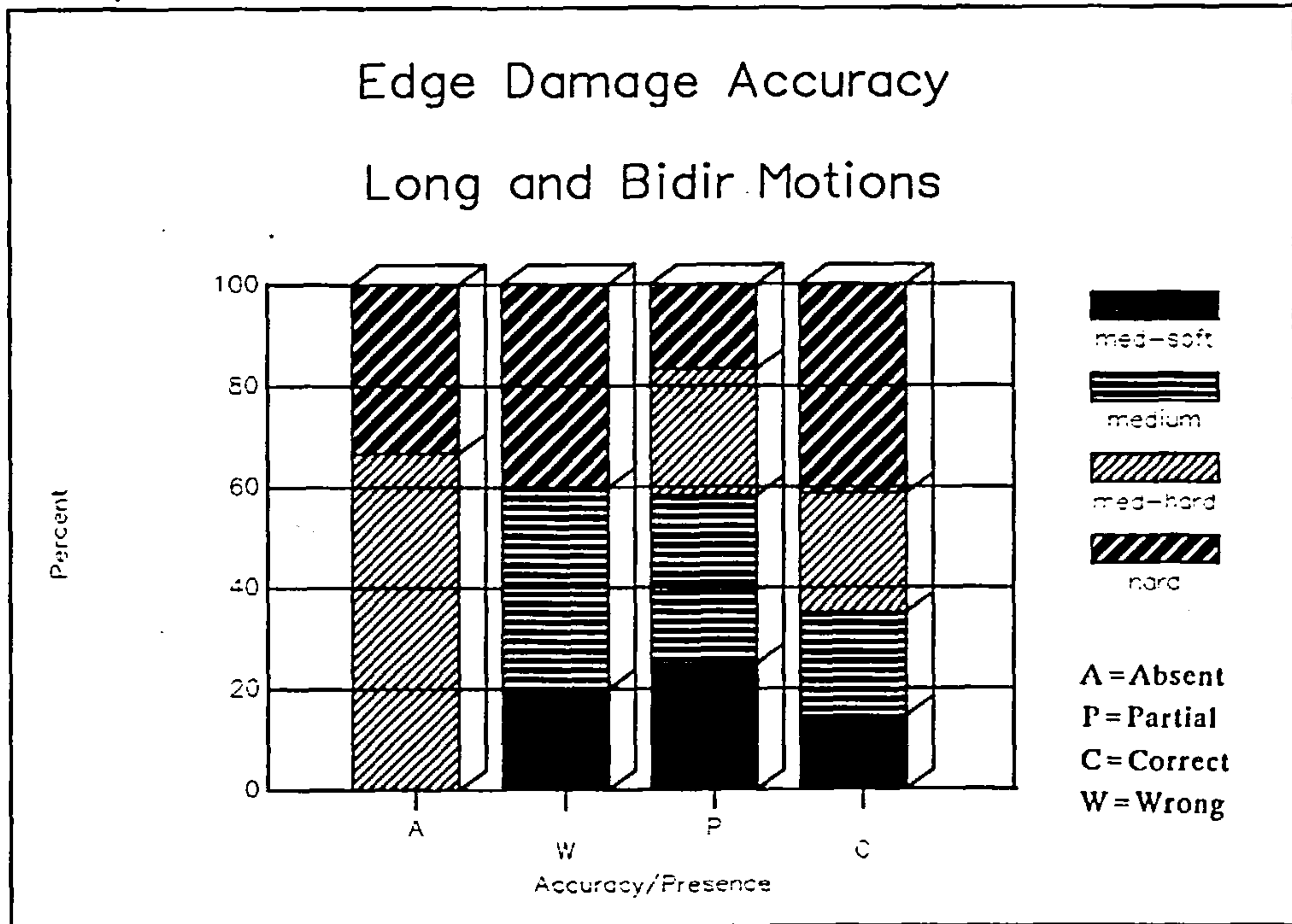


Fig 7.12b

surprising is the absent edge damage from longitudinal motions (fig 7.12b), which all comes from the two hardest categories. This is partly explained by the fact that this includes *delicate* working of bone and antler points, but is another reminder that functional evidence cannot be treated in a simplistic manner. Polish accuracy (fig 7.13) is different again. For longitudinal motions there is little apparent variation between material hardness, but there is for the transverse motions. The most notable feature here is the dominance of hard materials in the absent and wrong categories. The absence is explained by the number of cases where edge damage has occurred faster than polish development. The wrong or misleading cases are largely a function of the fact that many transverse motions on hard material involve a very low angle of tool in a shaving motion. As noted above, this low angle in a transverse motion, if accompanied by penetration into the material, may cause misleading traces to be produced.

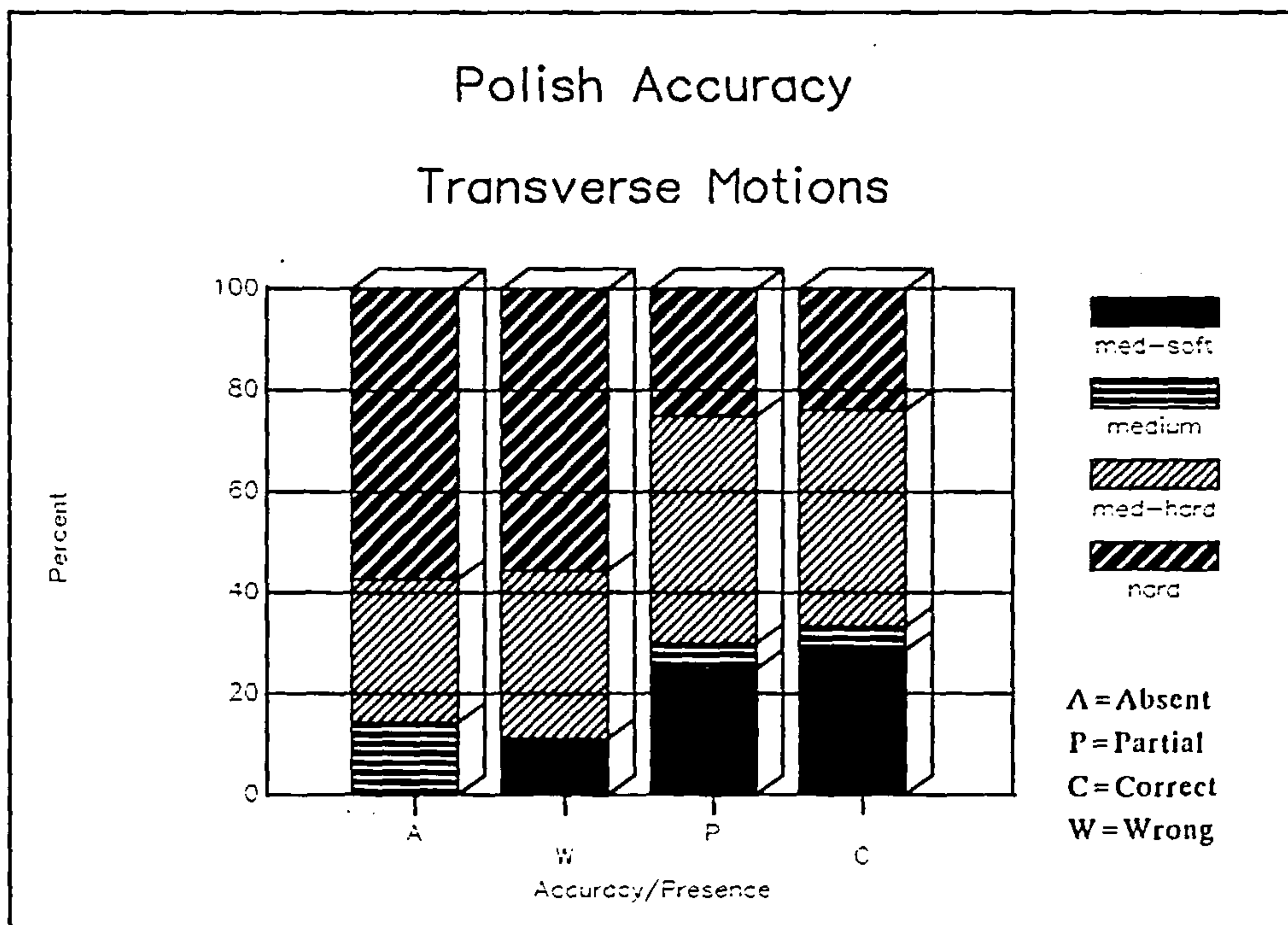


Fig 7.13a

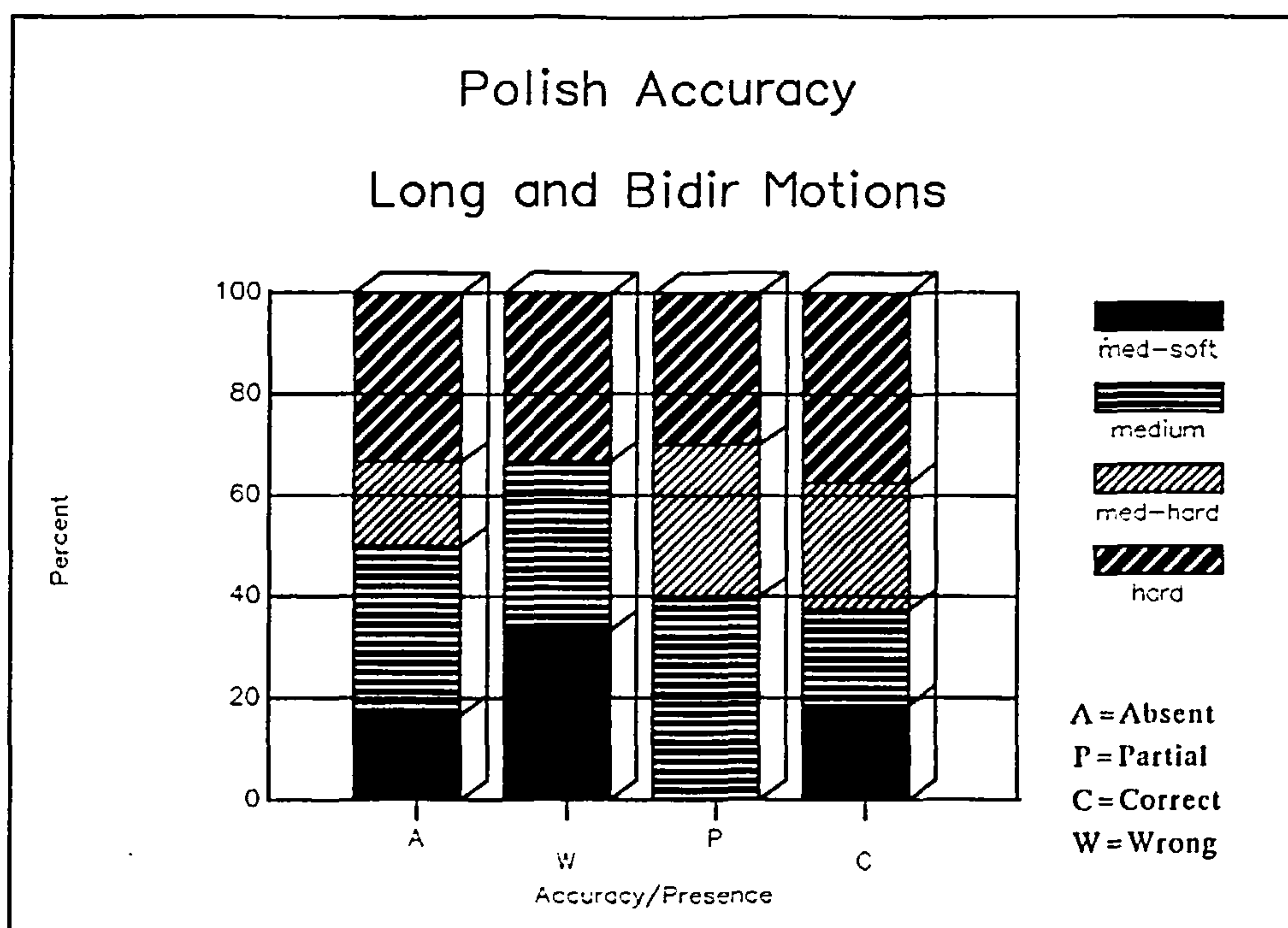
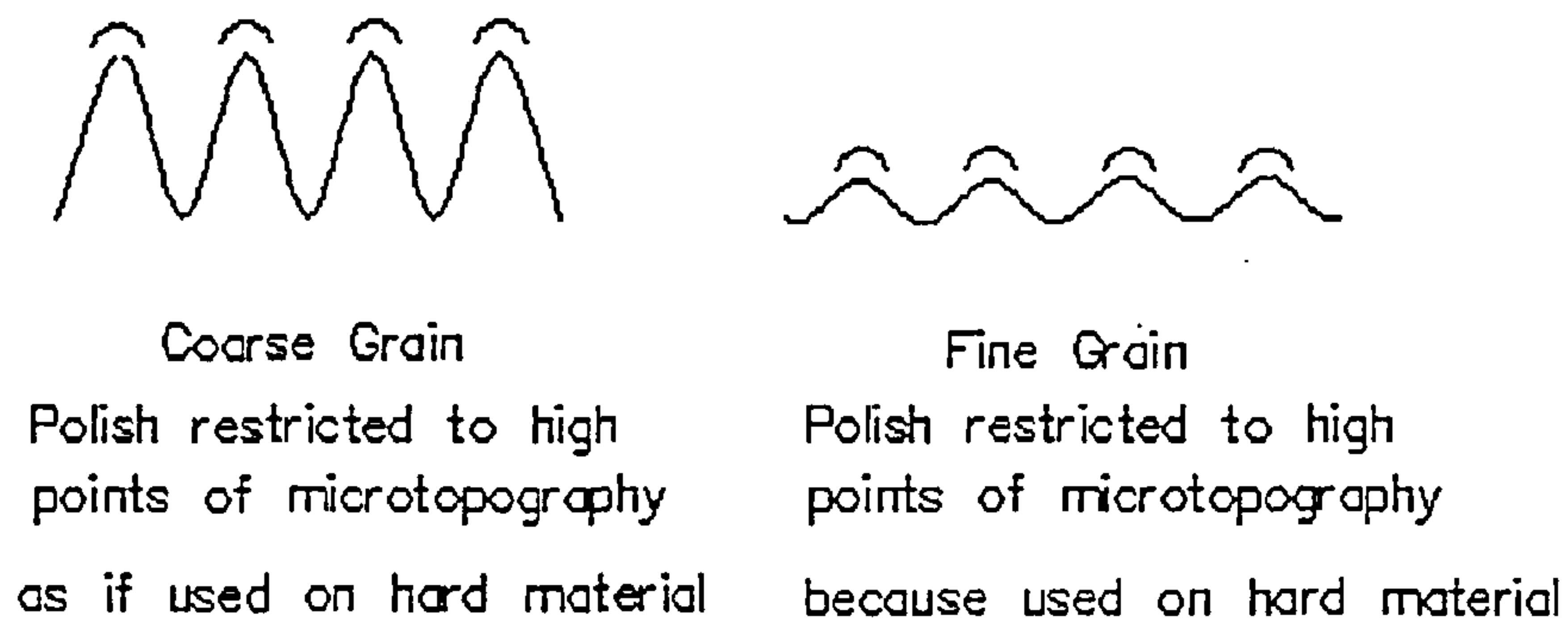


Fig 7.13b

Worked Material: The experimental programme showed that polishes (or any other combination of features) do not give a direct one-to-one indication of specific worked material. The number of variables that appear to affect trace development are too many. What can be done, once the degree of relative hardness is established, is to estimate the most likely material to have caused those traces. Even if high levels of accuracy are obtained here in blind tests, this process is totally interpretative, and not based on precisely diagnostic features. The extension of such work to prehistoric material is difficult, unless additional information is present.

In addition to the above general points it was noted that there were differences in trace development between tool materials. These were largely the result of texture, or the presence of crystalline quartz. These features tended to inhibit the development of polish patterns, and made patterns of edge damage less predictable. The texture of the tool material is significant as it is one of the two primary contact surfaces between which pressure occurs. In general the chert produces less diagnostic wear traces than chalk flint. It is essential to monitor surface

texture so that it is clear that, for example, a scattered polish pattern is the result of the worked material, and not caused by a coarse textured tool (fig 7.14).



Similarity in polish from different contact materials caused by
different tool materials

Fig 7.14

Controlled Tests

In these tests the emphasis was on testing various hypotheses, and testing the effects of various particular variables on wear traces. Most of the "Post-Depositional" tests fall into this category, as do the experiments on polish development between different tool materials and different worked materials. It has to be admitted that although the experiments were rigorously controlled compared to the "simulation" experiments, control was not as rigid as standards accepted in material science.

Post-Depositional Effects

In some respects the "post-depositional" experiments are simulation experiments, especially the trampling ones. However, as the majority of these experiments were conducted in entirely artificial circumstances, they have all been included with the controlled experiments.

Trampling 1:

A small number of pieces (5) were buried at the entrance to the volunteers' shelter at Mosphilia, and left there for the 8 weeks of excavation.

Results: Significant quantities of edge damage were produced, mostly random in distribution. Polished patches were also found. These were small, randomly distributed on raised areas, such as dorsal ridges and retouch scar perimeters. The individual spots of polish might be mistaken for use, were it not for their distribution.

Trampling 2:

Fourteen chert pieces were buried in a regularly used path in a garden. These were left in place for 18 months, and experienced a wide range of weather conditions, including frost and snow. Animal burrowing effects were accidentally reproduced by the illicit excavations of small children. Not all the pieces were successfully recovered.

Results: The effects produced by this process were random. Some pieces suffered hardly any damage, while others had appreciable areas of edge damage, occasionally difficult to isolate from use. Polish was not a serious problem. Some pieces had developed an extremely diffuse gloss, but only one piece had any real "polish".

Artificial soil movement:

A number of pieces were placed in the base tray of an automatic sieve-shaker and shaken in a variety of media (sand, sand and pebbles, organic rich topsoil) for varying lengths of time, with varying moisture content.

Results: Loosely packed sand and stones produced the most edge damage, but most pieces were damaged to some extent. Most of the edge damage was however clearly random in its distribution around the pieces. Topsoil produced the most polish. Most polish had a random distribution around the tool, but with a concentration on the protruding parts of tool morphology, such as dorsal ridges. This could cause serious problems, if only a few areas were affected, leaving most of the tool fresh, as many of the polished areas had polishes very similar to those produced by use. Generally the edge damage and polish patterns did not coincide as would be expected on genuine used pieces.

General Conclusions:

Post-depositional effects can be a serious problem in trace analysis. This problem can be made worse by the use of individual types of wear features (polish or edge damage) in isolation. It is possible to reduce the effects of the problem. The use of large samples helps to identify and screen out random noise, the use of multiple evidence types allows confirmation of the evidence, and patterns and regularities in the evidence can be recognised.

Contact experiments

A programme of experiments was undertaken in which a selection of seven worked materials were rubbed with a range of eight lithic materials. All the 'tools' were examined prior to rubbing to select flat areas, with no technological features already present to confuse the data. All of the pieces were rubbed against each contact material for 5, 15 and then 30 minutes with steady pressure. A straight backward and forward motion was used throughout. The contact area was kept the same for each cycle. All pieces went through each cycle of rubbing and examination together to help ensure standardisation. All residue was left on material for a minimum of one week before washing to allow any chemical effects to take place. To ensure continuity between each cycle, accurate drawings of the location of each piece on the microscope stage

were made. On subsequent examinations pieces could be placed in exactly the same position. This meant that the same areas of surface were scanned during each examination. Each piece was scanned at 50 and 100x to describe overall trace patterns. Polishes were described at 200x at fixed sampling points. Details were checked at 500x (examination at this magnification made normally possible in this study by the selection of flat pieces) to ensure the maximum resolution of description with a light microscope. This not only ensured continuity, but also allowed comparisons to be made across a tool surface.

The purpose of this series of experiments was to concentrate on the effects of two variables on polish developments. The variables were the two primary contact surfaces; the tool material and the worked material. It was hoped that by eliminating variables such as contact angle, depth of penetration, and working motion and by keeping worked material constant, it would be possible to determine the importance of worked material and tool material to polish pattern.

Despite a large number of variables being recorded, no simple clustering of polish types and worked materials could be produced. General trends were however visible, but it is clear that these are in part connected to tool material microtopographical variation and not just worked material. In general the following points can be made:

- 1) Simple polishing does not rapidly produce a polish (as the polishing was done by hand, time intervals can easily be compared with normal tool use). The increased (and differentiated) pressures caused by penetration into a worked material, even if only slight as in some scraping activities, generally produce polishes faster. In other words, polish production is clearly also related to task activity.
- 2) Different worked materials do not produce a simple one to one individual polish that can always be distinguished.
- 3) Tool microtopography is a very important variable in polish pattern development.

- 4) Time is a very important variable, and different materials (tool and worked) will inter-react with time to produce different sequences of polish pattern development.
- 5) Different worked materials have different thresholds of visibility. Working a soft material may not produce any traces initially, and when traces are first produced they will be weak.

A very simple analysis of the data illustrates the variations. If all the tests that produced no polish are examined, it can be seen that fresh veg has the greatest number of "no polish", followed by cooked bone (fig 7.15).

TOOL MATERIAL BY WORKED MATERIAL						
No polishes produced						
MATERIAL	ECF	GBB	GMC	RKC	BPF	LDC
-----	---	---	---	---	---	---
COOKED BONE	1	2	2	0	0	0
DRY ANTLER	0	2	0	0	0	0
FRESH BONE	1	0	0	1	0	0
FRESH VEG	2	2	1	1	1	2
SEAS'D WOOD	0	0	0	1	1	0
SOAKD ANTLER	1	0	1	0	0	0
SOFT LEATHER	1	0	0	0	1	0

Fig 7.15

Fig 7.15 also suggests that there is a relationship between tool material and worked material. This is more evident in fig 7.16. Here it can be seen that ECF (chalk flint) is the material that has the most "no polish". The explanation for this variation is in the texture of the material surface. The fine grained surface of the chalk flint provides little 'bite' to vary pressure, and cause polish development. Depending on the surface texture, and the presence of fissures, the other materials vary in rate of polish development.

TOOL MATERIAL BY STAGE		
No polishes produced		
MAT	1	2
----	-----	-----
BPF	3	0
ECF	5	1
GBB	3	3
GMC	3	1
LDC	1	1
RKC	3	0

Fig 7.16

By plotting worked material against the test stage, the variation in the development of polish per worked material can be seen. In Fig 7.17 the different materials are plotted in order of number of "no polish" results. Fresh veg is at the top of the table, but the order of the other pieces can be seen more clearly. Only fresh veg and cooked bone have unpolished pieces by the end of stage 2. Dry reindeer antler is at the bottom of the table. The position of soft leather with most of the other hard materials is the only surprise. Its presence there is probably a reflection of the importance of moisture as a lubricating agent, increasing the "softness" of materials. The leather used in this experiment was completely dry.

WORKED MATERIAL BY STAGE		
No polishes produced		
MATERIAL	1	2
-----	----	----
FRESH VEG	6	3
COOKED BONE	3	2
FRESH BONE	2	0
SEAS'D WOOD	2	0
SOAKD ANTLER	2	0
SOFT LEATHER	2	0
DRY ANTLER	1	1

Fig 7.17

These relationships between tool material, worked material and time can also be seen if the number of different polishes produced per stage are examined. Fig 7.18 details the number of different polishes of worked material by stage, ordered by number of polishes. Fresh veg has

the lowest number of polishes, soft leather follows fresh veg, in contrast to its position above, but an accurate reflection of its hardness. This table (stage 1) is probably the best reflection of material hardness. It should be noted, that condition makes a serious alteration to the position of bone and antler. This emphasises the fact that polish pattern is determined by relative hardness, not by specific material. (Variations in later stages reflect the increasing homogeneity of polish on harder some materials.)

WORKED MATERIAL BY STAGE NUMBER OF POLISHES PRODUCED			
MATERIAL	1	2	3
-----	--	--	--
FRESH VEG	2	8	18
SOFT LEATHER	7	12	18
COOKED BONE	8	14	17
SOAKD ANTLER	10	16	24
SEAS'D WOOD	11	16	21
FRESH BONE	16	21	24
DRY ANTLER	20	19	19

Fig 7.18

Fig 7.19 also details the number of polishes produced per stage, again ordered by number of polishes, but this time in terms of tool material. Again it clearly shows the significance of tool material to polish development. The position of the two Cypriot cherts (GMC and CRC) should be treated with caution, as their position in the table is partially caused by natural glossiness, sometimes difficult to separate from early stages of polish development. This is particularly true of the CRC pieces, although they also have numerous textural variations like the cherts.

It can be seen from fig 7.19 that the difference between materials appears to be reduced through time. This is an exaggeration of the true case, as the individual polish patterns on each material remain different, but is partially correct, as the polishing processes do smooth out some of the material differences.

TOOL MATERIAL BY STAGE NUMBER OF POLISHES PRODUCED			
RAW	1	2	3
---	--	--	--
ECF	3	11	17
BPF	7	12	17
GBB	5	6	11
LDC	6	7	16
RKC	8	15	16
GMC	9	11	17
TVC	11	17	20
CRC	25	27	27

Fig 7.19

From the above points it is clear that a) polish identification methods cannot be adequate by themselves for analysis and b) the attribution of specific individual worked materials to tools on the basis of such analysis is dubious. On the above pieces the greatest difference between polishes was between areas on pieces that had "bite", produced either by running over a dorsal ridge, or a fissure, or by an area of very coarse grain. This "bite" cut into the worked material, and increased local point pressures, causing a much faster build-up of polish.

General Conclusions:

The experimental work undertaken points to the following general conclusions:

- 1) Functional analysis cannot be based solely upon polish identification.
- 2) Absolute determination of individual tool function, especially at the level of specific worked material, is unlikely to be achieved on the majority of artifacts.
- 3) There are thresholds of visibility in functional analysis. This will inevitably bias the archaeological record. Great

care has to be taken to try to distinguish the less visible wear traces from traces from other causes.

4) Accidental trace production, or Non-Use-Wear, is a significant problem, but its effects can be mitigated to some extent by an awareness of the problem, and the use of several features to determine use.

5) There are certain levels of information which can be reliably recovered. An appropriate methodology can make use of these in the examination of the overall patterns of wear traces on a sample of pieces. Individual examination of isolated pieces, or the treatment of pieces as isolated islands of evidence in the examination of a sample, is unreliable.

This work is in general agreement with the results produced by the blind test series at the Institute of Archaeology. As such the two studies represent independent and different lines of evidence to suggest that at present functional analysis is more limited in its ability to diagnose tool function than has been suggested. More variables concerning polish are retained here than in Grace's work (Grace 1989). They have been found to be helpful, particularly information on the development of the polish into the microtopography (flat, domed, invasive). This may be a function of the study of coarser-grained materials (some cherts) that have a greater variation in surface microtopography than flint. Some of the variables still retained here are either redundant or virtually synonymous, but have been kept to continue testing of validity, and to allow comparisons with other analysts work.

8: Methodology of classification

As a simple "tool x was used for task y on material z" interpretation is not used here, it is necessary to discuss the interpretational framework developed. A hierarchical method of interpretation is used. The theoretical basis for employing this method is discussed above in the section on general theory. The first stages of this incorporate little or no real *interpretation* in absolute terms, but rather a standard recording, and internal classification.

Preliminary Work:

The essential first stage is the recording of the data, in a manner that allows it to be analysed. This rules out noting "polish types". This first step is simply to record the traces on all pieces examined (according to the system outlined in appendix B), and then to internally compare these traces, with reference to the tool types, the location of traces, and experimental work. This step is designed to give some comparative data on the traces on tools. The examination of presence/absence of traces on tools is done, and tools with an excessive degree of ambiguity (caused for instance by heavy patination or burning of a tool) are removed from the sample.

First Stage:

The next step is to take this information and to divide the material into six categories. These are:

- 1) Unused, pieces that show no visible traces, pieces noted as being remarkably "fresh".
- 2) Lightly Used, pieces that have clear, but minimal, traces of use.
- 3) Heavily Used, pieces that have clear evidence of "heavy" use, either from "heavy duty" use, or from prolonged use.

- 4) Technological, pieces that have traces that can best be explained as the results of the tool manufacturing process.
- 5) Non-use-wear, pieces that have traces that can only be explained by accidental damage, as for example PDSM, (Post-Depositional Soil Movement), but not restricted to that.
- 6) "?", pieces that are a problem. These include any piece that cannot be included in one of the above categories.

From this classification process, much useful information can be gathered. Percentage figures for use, and intensiveness of that use, can be generated for tool types, from area to area within a site, and from site to site.

Second Stage

This step allows a comparison of the various elements of the traces. Simple analysis is possible. Do all tools of the same type that have traces on them display a similar pattern of traces (location, overall type, etc)? Do any other tools (and here all sampled pieces are included as potential tools, regardless of typological classification) have the same pattern? Are any other patterns discernible? Are there absolutely no patterns? It is now possible to start to use the functional data in a more general *archaeological* way, as appropriate to the specific study. The objectives that were originally defined during the planning of the functional analysis can now be examined.

Third Stage

This stage involves the initial interpretation of the traces in the light of the experimental data accumulated. This is the first time that the traces themselves are actually subjected to detailed interpretation. The goals are still limited.

This step involves an attempt to further refine the two used categories. In particular the heavily-used class where the traces of wear are better

developed and therefore more clearly defined. These steps separate the tools used on soft materials from those used on hard materials and where possible to separate the broad classes of motion of tool use. This information can be used to further refine the picture of activity built up already.

From the data gathered so far, it will not be possible to continue the interpretative process any further in most cases. Indeed by this stage, many tools will have already been removed from the sample, as not having traces that can be interpreted in terms of motion or whatever. This is a prime purpose of the sequential method of interpretation and classification, in that the earlier stages allow useful information to be obtained from the large sample initially selected.

Fourth Stage:

Occasionally some tools may have traces on them, that, taken in conjunction with the other data available to the functional analyst, will allow further interpretation. A good example from this study is the case of the tools used to drill sherds at Mosphilia. These are described in more detail below, but it is sufficient to say here that experimental use produced drilled sherds with identical features to the archaeological ones, and that the traces on the tools matched those on some archaeological items.

Fifth Stage:

As suggested by the blind test work above (chapter 4), particularly piece no 13, where the analysis was correct in details of motion and material, but the interpretation completely wrong, there is a final stage in functional analysis. This is to decide what the *intention* of the tool use

was. For test piece no 13 that was fire lighting, for other tools it might be, for example, tool making. Obviously the degree of precision varies, and equally obviously it is difficult to conduct this type of work from the wear traces alone. It may be possible from other evidence to be very precise about how tools have been used (for example in the case of burin spalls as drill bits from Jebel Naja, see below). It may even be possible to be that precise without the best of evidence from the traces on the tools, if there is enough good circumstantial evidence to support what information can be directly derived from the tools. This stage may be turned around, if it is clear that tools have been used to perform a specific function without recourse to functional analysis, and very detailed manufacturing information may be sought (cf Calley and Grace 1988).

Reporting:

Because of the nature of this classification system, designed around both the problematical nature of the evidence and the theoretical purpose of the analysis, it should be clear that reports produced having followed this system will not be designed to go into great detail on individual tool function. Rather, they will deal with patterns of wear traces. However, because of the problematical nature of the evidence and the possible need for future reinterpretation, it is essential to present a piece by piece catalogue. As a result two separate parts of a report need to be produced, one, where the analysis of the sample is discussed, and the second, where a simple catalogue of the pieces and the traces located on them is presented. This division is followed in Part 2, where the discussion of the analysis, and its integration with the rest of the projects analysed, is given in the main text. A basic catalogue for each case study is presented in appendix form.

Conclusion:

This step-by-step system, deliberately cautious, helps to keep the different levels of interpretation separate. It is possible to examine how

much information used comes from the relatively secure early stages, and what comes from the more problematic and error-prone stages. It also allows the many tools that have some form of evidence of use, but limited for one reason or another, to be utilised in the assessment of the sample.

Part 3

Case Studies

"Each object exists in many relevant dimensions at once, and so, where the data exist, a rich network of associations and contrasts can be followed through in building up towards an interpretation of meaning."
(Hodder 1986: 139)

9: Case Studies, General Introduction

The method developed in Part 2 was tested by analysing a number of archaeological assemblages from a variety of sites. This testing was not a simple one-way process. From an early stage in the project results from the case studies were used to improve the method. The criteria used in the theoretical and experimental processes were tested for applicability to "real" material. For example, the absence of "diagnostic" polishes in the experimental programme was matched by their absence in early case study work. Features that were observed in case study work were recorded and searched for on experimental material. Hypotheses of use (explanations of wear traces on tools) were tested in experimental work. The two processes are inseparable, and although the research emphasis has now turned to the archaeological material, the development of the method and experimental testing continues. The result of this has been that the archaeological samples were examined several times, particularly in the early stages of the project. New methods and recording systems were used as they were developed. Where possible, all pieces analysed in this study were re-examined using the 'latest method' (pieces examined in Cyprus and pieces metalised for SEM were of course unavailable). This cycle of reexamination has refined the process and was an essential part of the development strategy - but has at the same time limited sample size.

As stated in Part 2, the aims of this functional analysis are not to ascribe very specific functions to *individual* tools, but to examine issues that are of greater general importance in archaeological interpretation. The main areas examined are:

- 1) Different uses of raw materials, different values of raw materials
- 2) Local responses to different raw materials (and their relative availability).

- 3) Functions of "classes" of tools: are they homogeneous or variable
- 4) Use rate of tools and blades and flakes
- 5) Evidence of curation versus expedient tool use
- 6) Variations in patterns between sites

10: The Mesolithic in Scotland

With the exception of rare sites such as the Oronsay shell middens, few Mesolithic sites in Scotland have good organic preservation. Most information is derived from stone tools, mainly from surface collections and mixed assemblages. Despite Myers (1987) declaration that stone tool studies are now no longer concerned with culture history and chronology, recent reviews (Myers 1988, Woodman 1988, Bonsall 1988, Clarke and Wickham-Jones 1988, Morrison and Bonsall 1989) have all concentrated on chronology, in particular the question of whether an early broad blade Mesolithic was present in Scotland. Mesolithic studies in Scotland are in their infancy, when compared with the rest of North-West Europe.

It is not surprising that when the evidence is apparently so poor (material from unreliable contexts, poor quality raw stone for tool manufacture, rare survival of organic material) the period is often perceived as marginal. There are two main explanations for this apparent paucity: 1) the nature of the sites, and 2) the nature of the assemblages.

1) The poor contexts for the material are largely the result of the type of occupation to be expected on hunter-gatherer sites, where long term occupation is not necessarily the rule, and short term, transient camps leave little evidence. Changes in sea level, particularly on the east coast, peat growth in the highlands and the West, and millennia of agriculture in the lowlands all contribute to the paucity of contextual evidence. Many Mesolithic sites are not located until eroded or exposed by ploughing.

2) The apparent paucity of the lithic assemblages is at least in part the result of the raw materials available for stone tool manufacture, which rarely equal nodular chalk flint in either quality or size. Some of the

apparent 'poorness' of the lithic assemblages is the result of local responses to the raw materials available. Although often not as aesthetically pleasing as the more regular artefacts produced on homogeneous fresh chalk flint, these local adaptations show a high standard of technical ability on "difficult" materials. Technical ability is also demonstrated by the flexible response to the different materials. However these responses do not always produce easily classifiable material.

The use of this limited evidence has mostly remained at a simple level, concentrating on the evidence of the microlithic component. While microliths are the most diagnostic element of the Mesolithic, they provide little information about the Mesolithic. They are only a small part of the recovered lithic assemblages, indeed in the "Obanian", with the possible exception of Risga (Morrison 1980: 158), there are few retouched tools of any sort.

Having suggested that basic typological analysis is of *limited* use in the Scottish Mesolithic, but at the same time accepting that at present the predominant form of evidence from that period is the lithic assemblages, it is essential to improve analytical approaches to this material. The Mesolithic in Scotland was seen as an ideal testing ground for the functional technique developed. The concentration on this aspect of the evidence is because of the focus of this particular project and should not be interpreted as meaning that the other evidence is unimportant. A basic principle of the method employed is that functional analysis can only be used as part of a multi-dimensional approach to lithics.

It is impossible to consider any aspect of the lithic process (procurement, manufacture, style and function) in isolation. The variables of raw material, technology, typology and function are all inter-related. Clearly the raw material limits the range of technological options, which in turn may limit the typological options. The limitations of form may limit the range of functional options available for *stone* tools (requiring replacement with other materials). It would, however, be wrong to think of this as a strictly one-way linear process: raw material--technology--typology--function. There is a complex interweaving of dependence and

design involved with typology influencing technology, and thereby *choice* of raw material. Technology can be modified to produce a desired *form* of tool by different methods. Function is an important fourth dimension that is frequently alluded to, but rarely considered except as an end point. Binford's work draws attention to the fact that function may at times indeed be a driving force. It is hard to isolate stylistic features until technical and functional attributes can be identified.

Other aspects of society will affect and be affected by lithic strategies. The lithic evidence is very important, but its significance should not be overstretched. It is therefore essential to consider all the other evidence available (for example environmental and ethnographic data) in the use of lithic evidence. Limits of time and space in this thesis limit the depth into which it is possible to go in all these areas, but it must be remembered that the concentration on lithics, in particular on functional analysis, is an artificial one.

Material from three sites has been analysed. The two inland sites from Dumfries and Galloway region, Starr 1 and Smittons, were sites where analysis commenced near the start of this functional study, gradually increasing through the testing process described above, and increased in the final process. Gleann Mor (Islay) was an assemblage studied after the bulk of methodological development had been completed.

The study of the Dumfries and Galloway material originally demonstrated the difficulty in working with non "chalk-flint" material presented in the first part of the thesis. The range of lithic materials utilised in the Scottish Mesolithic caused serious problems to a "conventional microwear" approach, but is part of the fascination of lithic studies of any kind in Northern Britain. The study of adaptive responses to different raw materials in different environments is at the heart of this work.

11: Smittons

The information regarding the excavation of both this site and Starr is derived from the notes and preliminary reports of the late Tom Affleck.

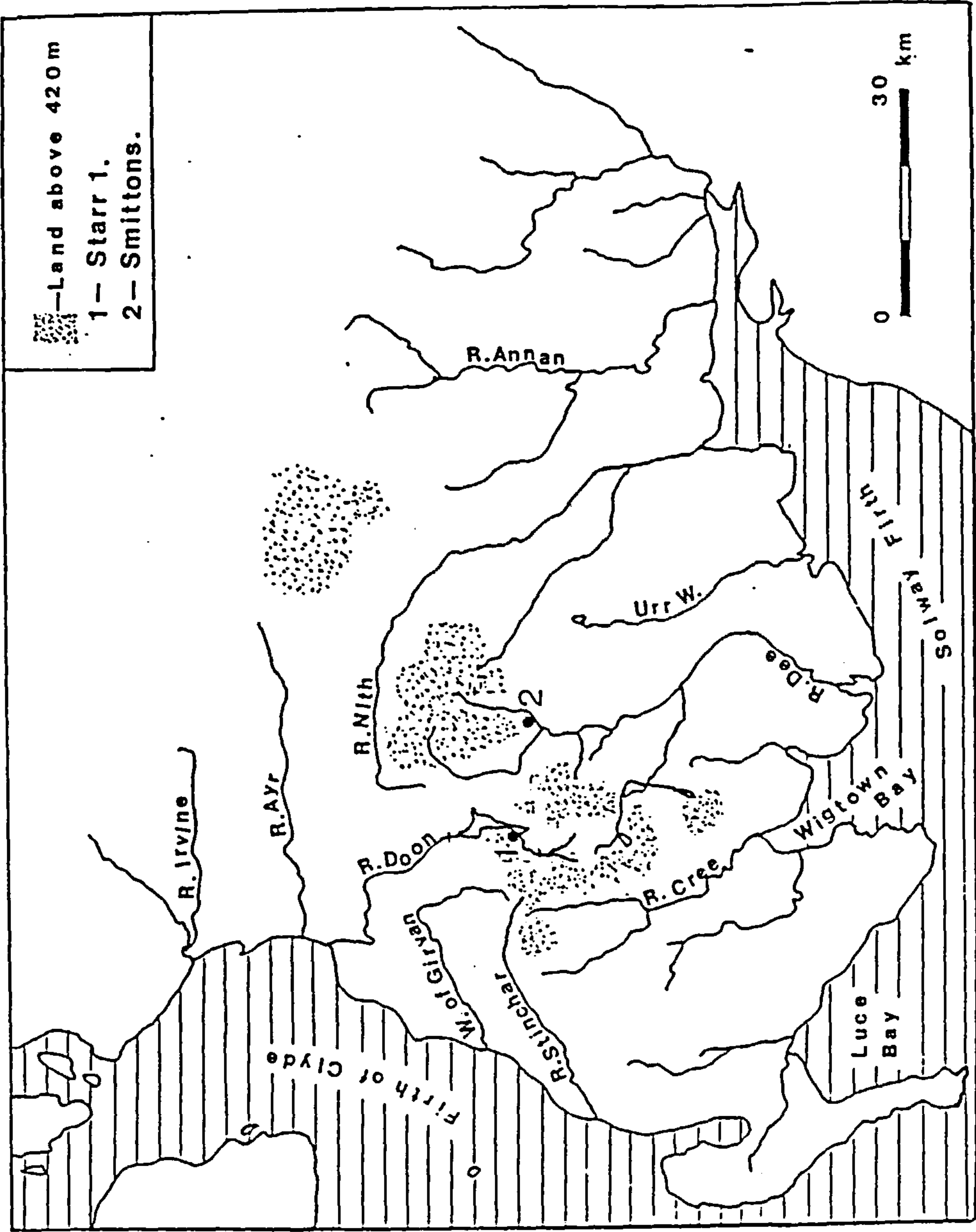
Site Description:

Smittons is a small Mesolithic site on the River Ken, Dumfries and Galloway Region (NX 635918 (fig 11.1), excavated by the late Tom Affleck. It is situated at a height of 184m OD, approximately 35km from the Solway Firth (Wigtown Bay) and approximately 45km from the Firth of Clyde. Access to the Solway Firth is down the River Ken and Dee. Loch Doon and the cluster of Mesolithic sites including Starr is about 15km away in a straight line. Land over 400m is close, and the site offers easy access to a range of environments. Four dates from the site are available, two of which are clearly contaminated with recent material (Edwards 1989). The more reliable dates are 5470 ± 80 and 6260 ± 80 (OxA-1594 and OxA-1595). There is a clear stratigraphic division of much of the site into an Upper and Lower level. There is also material which could not be assigned to these stratigraphic units. The material is treated in three units, the Total Assemblage, the Upper Assemblage, and the Lower Assemblage.

Raw Material:

Two principle raw materials were utilised on the site. Overall 73% of the material used was chert, 25% flint, with an insignificant quantity of quartz. A small number of pieces were unidentified, primarily as the result of extreme weathering or burning. There is a marked difference between the use of flint in the Lower assemblage (46%) and the Upper assemblage (29%) (Fig 11.2). As both these samples represent excavated material, it is unlikely that collecting methods or visibility of material are responsible for this variation.

Fig 11.1 Location map of Smittons



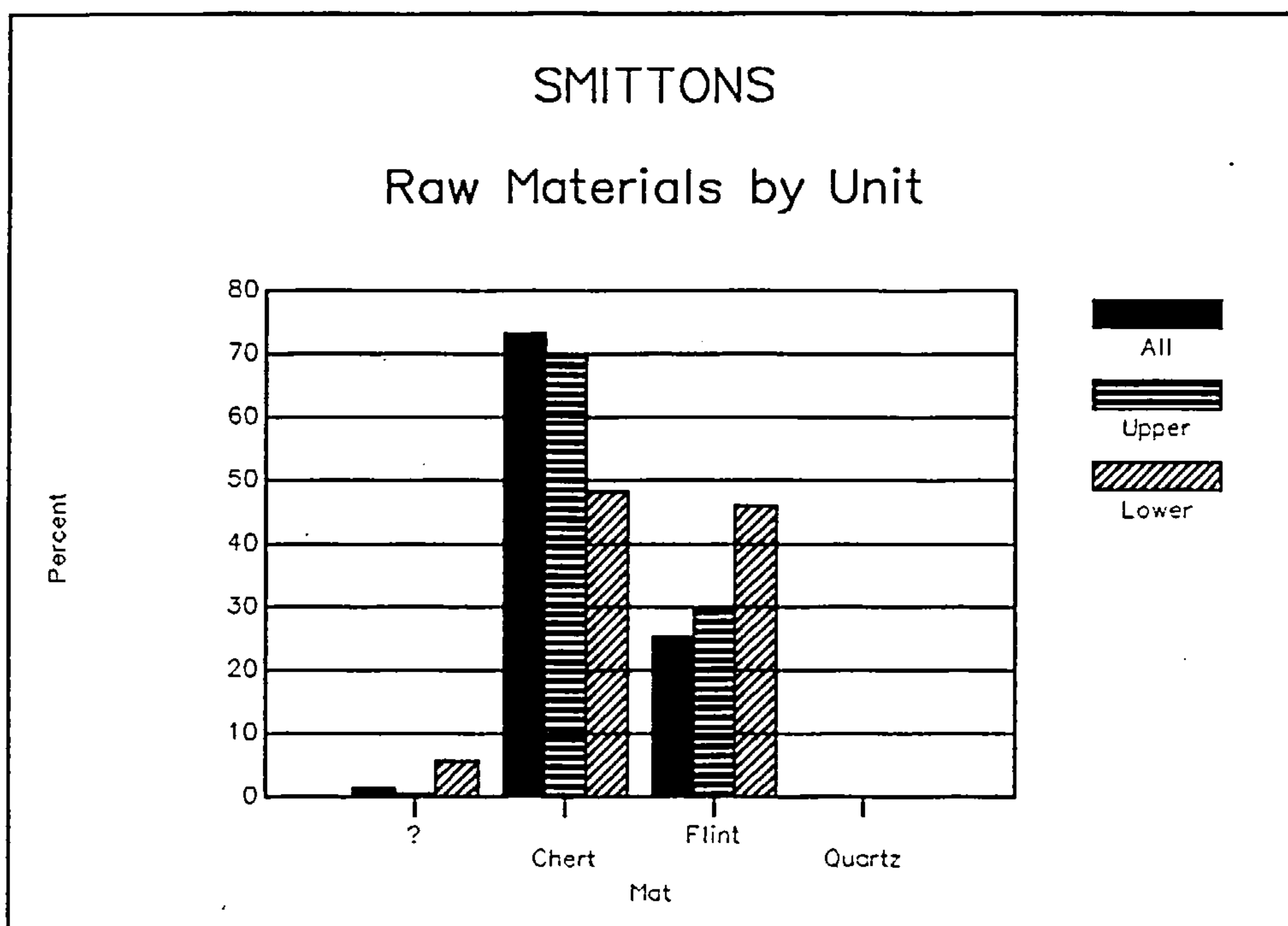


Fig 11.2

The relationship between the two materials is interesting. The most likely source for the flint is beach pebbles, probably from the Solway Firth (or the Firth of Clyde), although there is a possibility that glacially transported material might have been available (Morrison 1980). No such source has been located in the region. The chert is available throughout the Southern Uplands. It is locally available as pebbles in the river, and from an outcrop within 5km.

The flint almost certainly represents material imported from the coast. Because of the relatively greater homogeneity of the flint, it is often of superior knapping quality to the more variable chert. From this it can be hypothesized that the flint may have been imported and regarded as a more valuable material.

Technology:

The technology used on the site is typical of the Mesolithic, and consists of the production of small platform cores (tending towards a conical shape), irregular amorphous cores and occasional bipolar cores. There

is a difference between the flint and chert, easily seen in fig 11.3. There appears to be little variation between the layers.

Cores:		
	Flint	Chert
Platform	2	10
Amorphous	1	10
Bipolar	1	1
Frag	0	1
	4	22

Fig 11.3

Fig 11.3 shows that there are very few flint cores compared to chert cores. The overall proportions of the two materials in the assemblage would suggest a 3:1 ratio of chert to flint, not this 5.5:1 ratio. This pattern reinforces the hypothesis that the flint is imported as a special material, with most primary knapping occurring elsewhere, and few flint cores being brought onto the site. The overall patterns of flaking however suggest little major differential working of the two materials (Fig 11.4), apart from the large numbers of "chunks" produced during chert working. These pieces, caused by the tendency of the chert to split along natural bedding

Smittons		All		Upper		Lower	
		F	Ch	F	Ch	F	Ch
Flakes:							
Inner Irregular		67	192	16	58	14	13
Regular		30	73	13	24	9	11
Secondary Irregular		25	23	10	4	4	1
Regular		10	11	4	7	2	2
Primary		2	3	0	0	1	1
		134	302	43	93	30	28
Blades:							
Inner		28	69	9	26	9	5
Secondary		5	7	2	3	0	0
		33	76	11	29	9	5
Chunks:							
Inner		1	79	1	6	0	6
Secondary		2	27	1	5	0	0
		3	106	2	11	0	6
Total:		170	484	56	133	39	39

Fig 11.4a

Percent Scores						
	All		Upper		Lower	
	F	Ch	F	Ch	F	Ch
Flakes	20.5	46.0	23.0	49.0	38.5	36.0
Blades	5.0	11.5	6.0	15.5	11.5	6.5
Chunks	1.0	16.0	1.0	6.0	0	8.0
All	26.0	74.0	29.5	70.5	50.0	50.0

Fig 11.4b

Percent by Material, including "chunks"						
	All		Upper		Lower	
	F	Ch	F	Ch	F	Ch
Flakes	79.0	62.5	77.0	70.0	77.0	72.0
F+Chunk	80.5	84.5	80.5	78.0	77.0	87.0
Blades	19.5	16.0	19.7	22.0	23.0	13.0

Fig 11.4c

planes and irregularities in the material, rather than fracturing conchoidally, mean that the two materials are not easily comparable in terms of flake to blade ratios. This difference is an important point to note in the analysis of an assemblage with varying tool materials. It means that some variations may be the result of different reduction strategies for the materials, while some variations may be the result of the different fracture patterns of the materials.

If the chunks are considered to be primarily "failed flakes", as they are significantly less likely to come from prepared blade cores (made from selected fine homogeneous material) than amorphous flake cores, and are therefore added to the flake percentage scores by material, it can be seen more clearly (Fig 11.4c) that while overall there are roughly similar proportions of blades produced, with a slightly higher proportion of chert blades in the upper layer, in the lower layer there is a 10% higher proportion of flint blades.

The overall quantity of blades is 16.5%, lower than would be expected if the assemblage was a blade industry (Bordes and Gausson 1970). However the flint blades make up 19.5% of the flint, close to the required lamellar index of 20%. The score for the chert by itself is

15.5%. There is a difficulty with using Bordes and Gausson's index here, as their figure is based on the reduction of chalk flint. The fracture patterns of the chert mean that a lower lamellar index could still represent a technique designed to produce blades.

While the numbers involved are very small, it can be suggested that the flint came onto the site at least in a partially knapped state, and that in the earlier phase it was appreciated (or at least perceived) as a better material for blade manufacture. Experimental knapping during the course of this project demonstrated that the finer grained, more homogeneous lumps of chert flake at least as well as the beach pebble flint. While such homogeneous material is relatively uncommon within the naturally occurring chert, there are such large quantities of chert readily available that a "wasteful" economy can be developed, disposing of the poorer material.

Typology:

Typologically the assemblage is typical of the late Mesolithic. It is dominated by narrow blade microliths. Only a very small number of pieces have secondary modification (See Fig 11.5). These are almost exactly equally divided between flint and chert, which reflects a higher proportion of the rarer flint pieces being retouched than chert.

Smittons Tool Typology						
	All		Upper		Lower	
	F	Ch	F	Ch	F	Ch
Edge Damaged	16	31	6	4	3	0
Scraper	3	4	1	1	0	0
Bifacial Frag	1	0	1	0	0	0
Misc Ret	0	3	0	1	0	0
Microlith	11	15	2	7	3	2

Fig 11.5

The two classifiable retouched types, the scrapers and microliths, are, in terms of material, very similar in overall numbers, although in the Upper

layer chert microliths clearly dominate. Edge damaged pieces were recorded, although no functional meaning was attached to this group, and it clearly included pieces with accidental irregular crushing, as well as potentially used pieces with very regular fine scarring.

Smittons Percent by material						
	All		Upper		Lower	
	F	Ch	F	Ch	F	Ch
Edge Damaged	9.5	6.4	10.5	3.0	7.5	0
Scraper	2.0	1.0	2.0	1.0	0	0
Bifacial Frag	0.5	0	2.0	0	0	0
Misc Ret	0	0.5	0	1.0	0	0
Microlith	7.0	3.0	3.5	5.5	7.5	5.0
Total Ret	9.0	4.5	7.0	7.0	7.5	5.0

Fig 11.6

Fig 11.6 shows that in proportion to the quantities of material, flint is proportionately twice as likely to be retouched as chert. There are approximately one third more edge damaged pieces made of flint than of chert. These figures again reinforce the hypothesis that flint is an important material for tool manufacture. The proportion of edge damaged pieces could be seen as an indication of a greater incidence of use, although there is a possibility that flint pieces were damaged when transported in their 'ready-knapped' form. Both materials are represented in the two tool classes, suggesting that the two materials were intended for similar functions.

Percentage scores for the two archaeological horizons are given, but the samples are very small, especially from the lower unit. In both cases edge damaged pieces are dominated by flint. Proportionately more microliths are made of chert in the upper unit, and more of flint in the lower, emphasizing the change in absolute numbers. However, the proportion of chert that is made into microliths hardly changes between the two layers.

Typology of Microliths						
	All		Upper		Lower	
	F	Ch	F	Ch	F	Ch
Backed	6	2	1	1	1	0
Frag	1	3	0	0	0	0
Crescent	1	1	0	1	1	0
Point	1	0	0	0	1	0
Frag	0	1	0	1	0	0
Scalene	2	5	0	2	0	1
Triangle	0	1	0	1	0	0
Rod Frag	0	1	0	1	0	0
Frag	1	1	1	0	0	1
	11	15	2	7	3	2

Fig 11.7

The typology of the microliths (Fig 11.7) includes a selection of typical narrow blade forms. Although the numbers are small, it appears that triangle forms are dominated by chert, and simple backed elements dominated by flint.

Functional Analysis:

Sampling:

The entire lithic sample from this site was very small (694 pieces). This meant that a large proportion of the material could be examined (cf Vaughan 1985). A sample could be taken that included pieces traditionally seen as waste flakes and débitage. Pieces without any apparent sharp, regular, useful edges could be examined. This has several advantages:

- 1) On a broad sample such as this it is easier to observe random background "noise" caused by technological and post-depositional effects.
- 2) The relationship between different components of the material could be examined. Studies limited to one (or only a few) classes of material have inherent limitations. Even studies that, for example, include unretouched blades (Juel

Jensen 1986), are limited in their general applicability. To be able to state that the percentage of use in a particular class is high, it is necessary to have some background information, and to know what the overall use rate is.

A sample of 177 pieces was examined. Selection criteria included an examination of all retouched pieces. All pieces that had been recovered from the two distinct horizons and had been stored in individual bags were examined.

Analysis:

Stage 1:

Four pieces were omitted from the analysis, as trace analysis was not possible due to burning or excessive weathering. The initial breakdown of wear traces shows just 30% of pieces with traces of use, but an additional 8% with "opportunistic" use (Fig 11.8). While this last may be the result of use on soft materials, there was successful identification of such materials and the description of opportunistic use fits the marginal traces located. As such it represents a high score in relation to the "used" pieces.

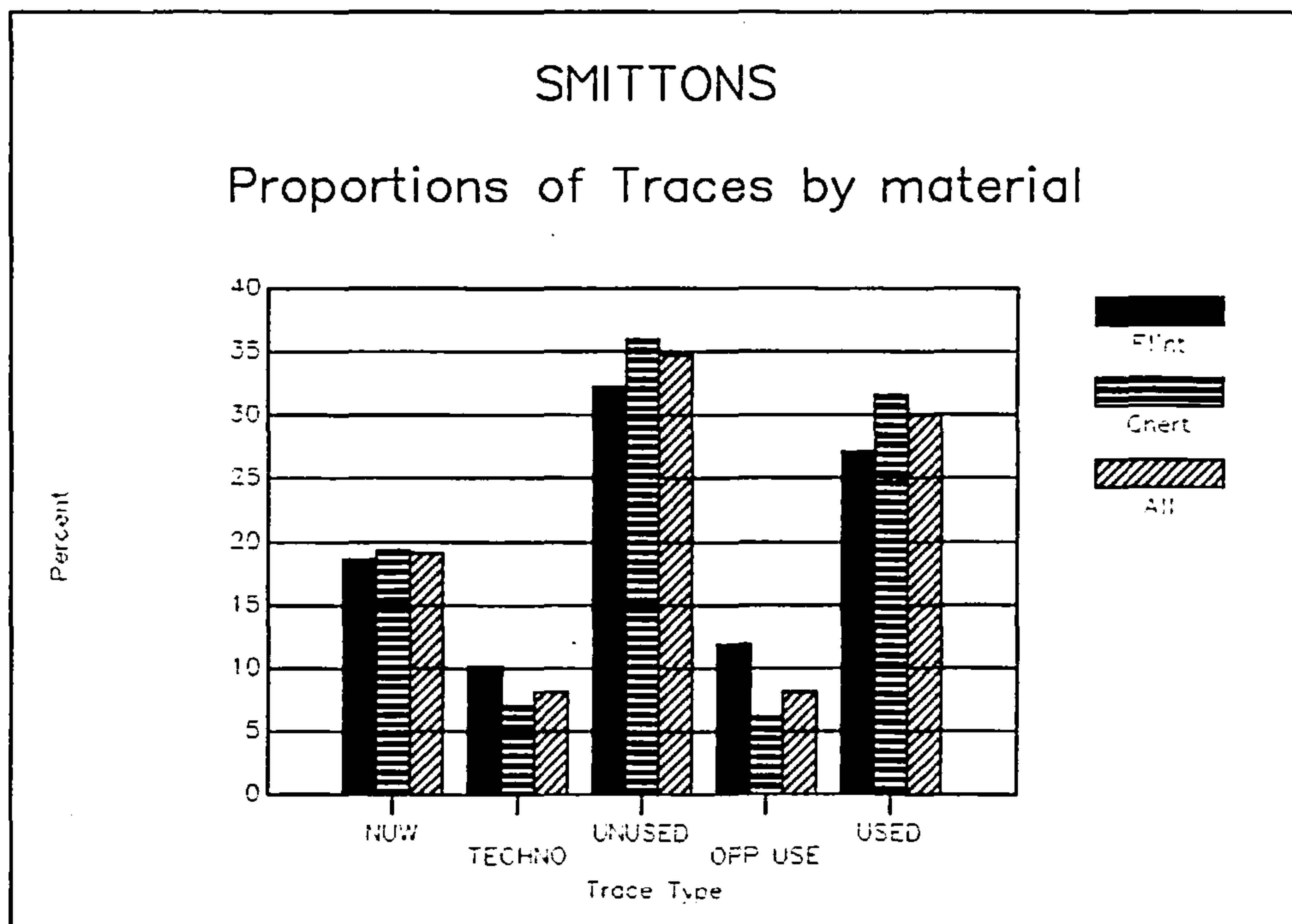


Fig 11.8

Surprisingly, there is little apparent difference between the use rate of flint and chert. With opportunistic (or light) use and used categories combined, chert has 38% and flint 39% total used pieces. Indeed, instead of the expected greater use of flint (the imported "better" material), the flint total includes 12% opportunistic use to the chert 6%. The opportunistic use category consists of pieces with light or marginal traces of use, the type of trace associated with an expedient rather than a curated pattern of use. Flint is not being more heavily used, but nor is it being saved unused.

Stage 2:

By dividing the material into three categories (Unretouched, Edge Damaged, and Retouched), an interesting pattern emerges (Fig 11.9). The unretouched pieces examined have the lowest proportion of use (20%), but the most use is in the edge-damaged category, with 50% use. Retouched pieces fall closer to the unretouched with 27% use. Opportunistic use follows the opposite

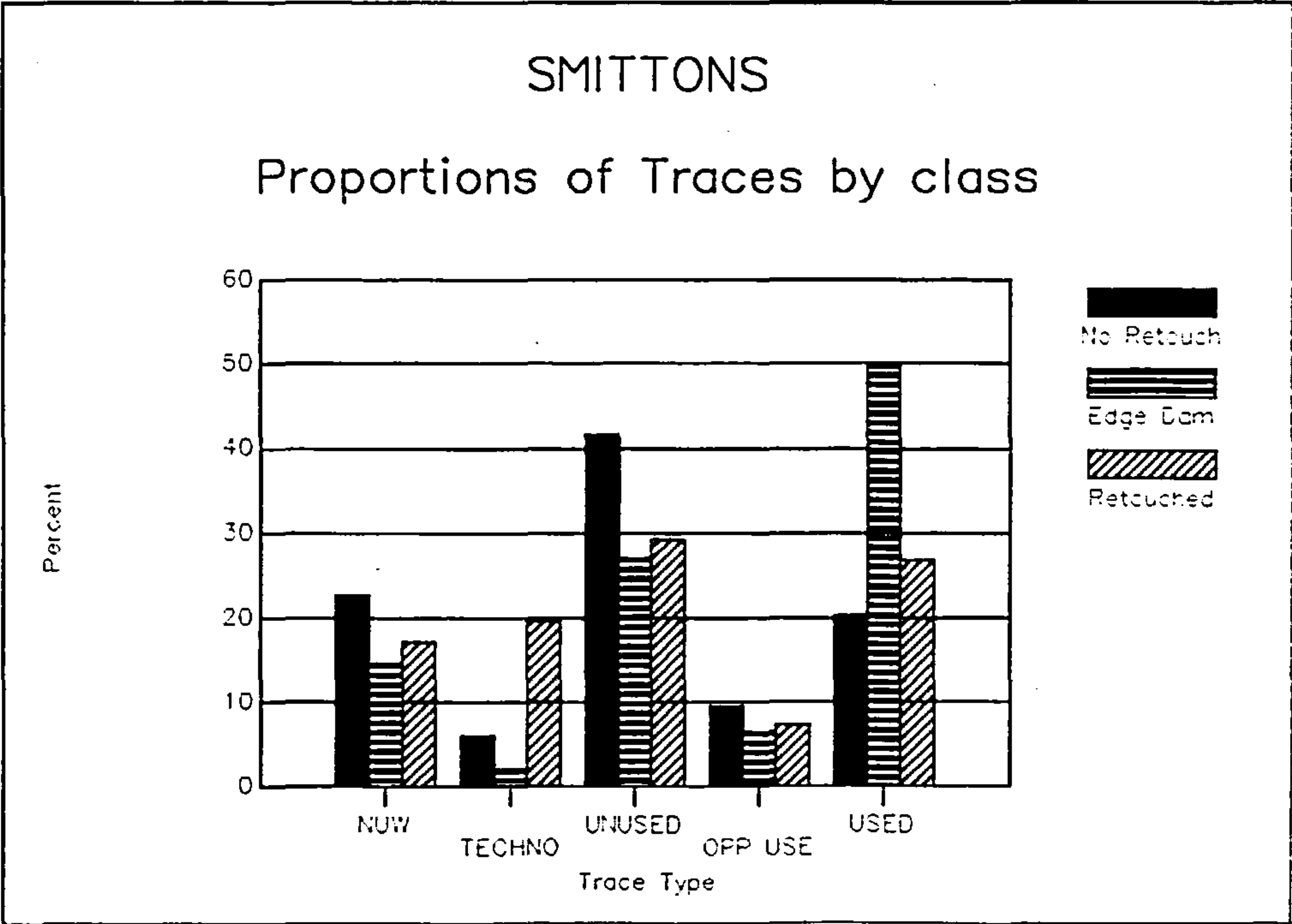


Fig 11.9

pattern, with unretouched pieces having the highest score at 10%, retouched pieces in the middle with 7%, and edge damaged pieces the lowest with 6%. (Of the unretouched pieces with techno traces, nearly all are cores, of which only one has any traces of use.)

An analysis of the sample by a combination of tool material and the three categories of retouched, edge-damaged and unretouched (figs 11.10a-c) does not alter the above patterns significantly, but does add some detail. It is clear that while the retouched flint pieces are divided almost equally between used and opportunistically used, chert retouched pieces are more intensively used (Fig 11.10c). With regard to edge damaged and unretouched pieces there is little variation between the two materials. The edge-damaged flint has a higher use-rate than the edge-damaged chert, while the unretouched chert has a higher use-rate than the unretouched flint. This may indicate that the flint is

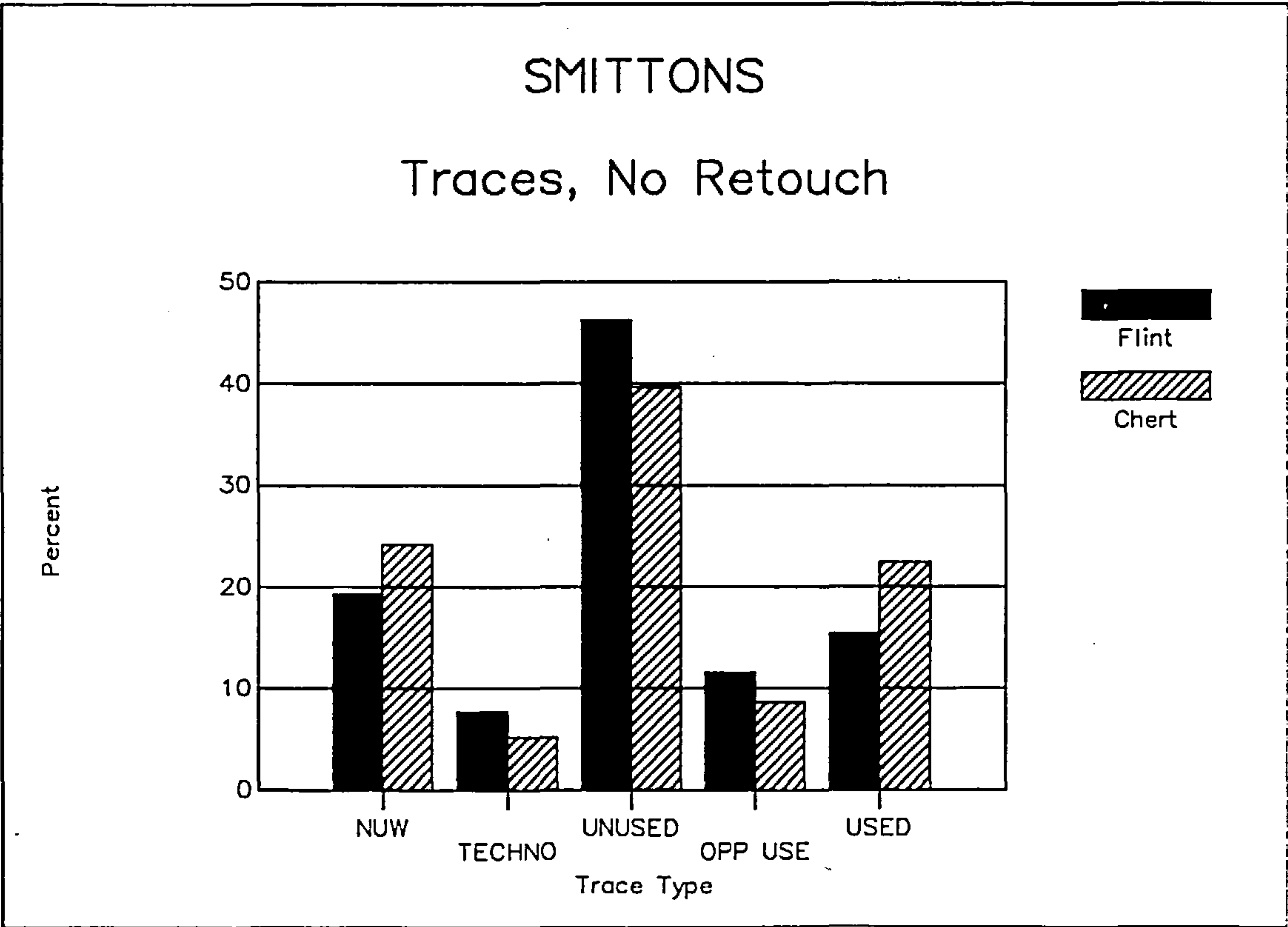


Fig 11.10a

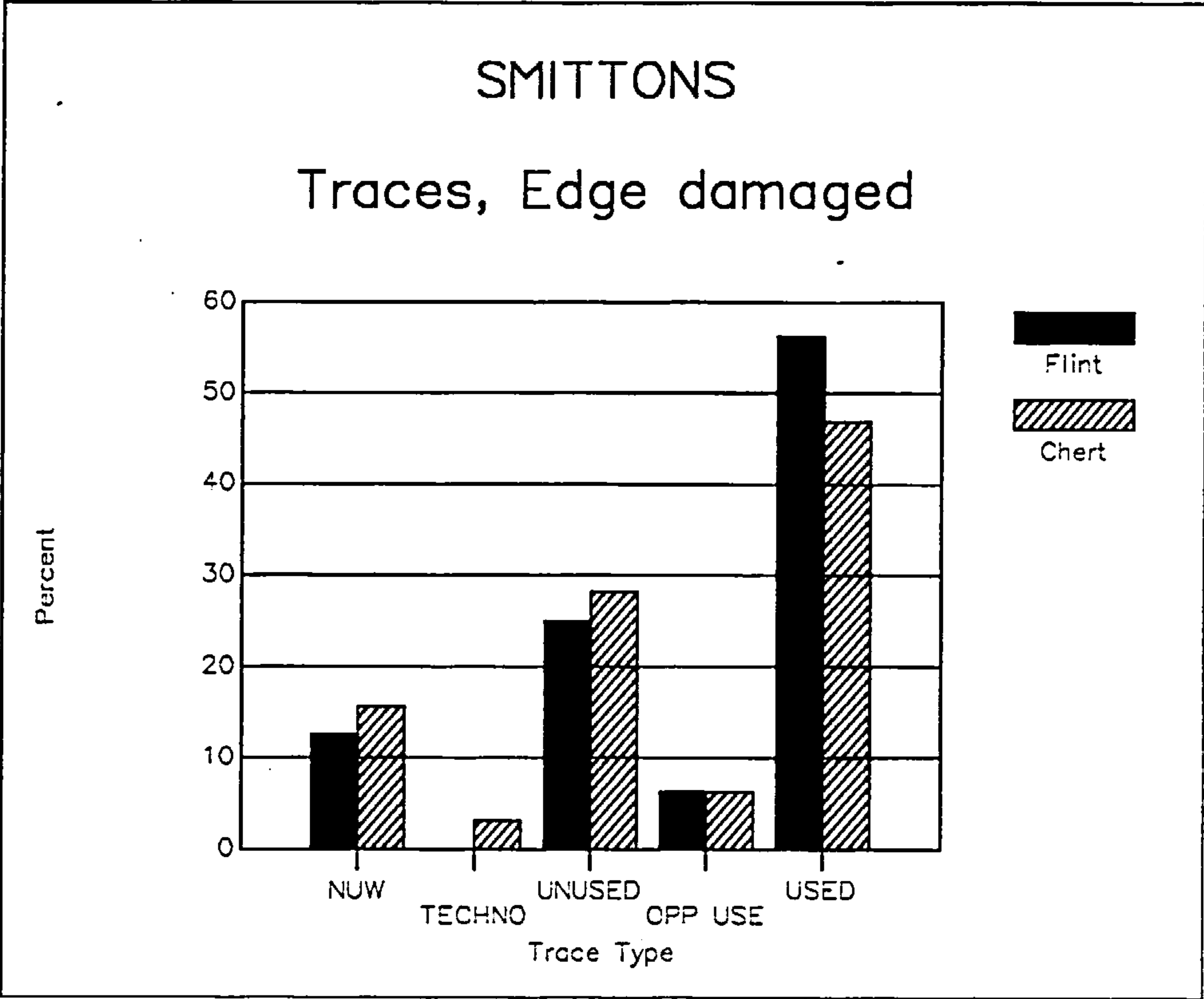


Fig 11.10b

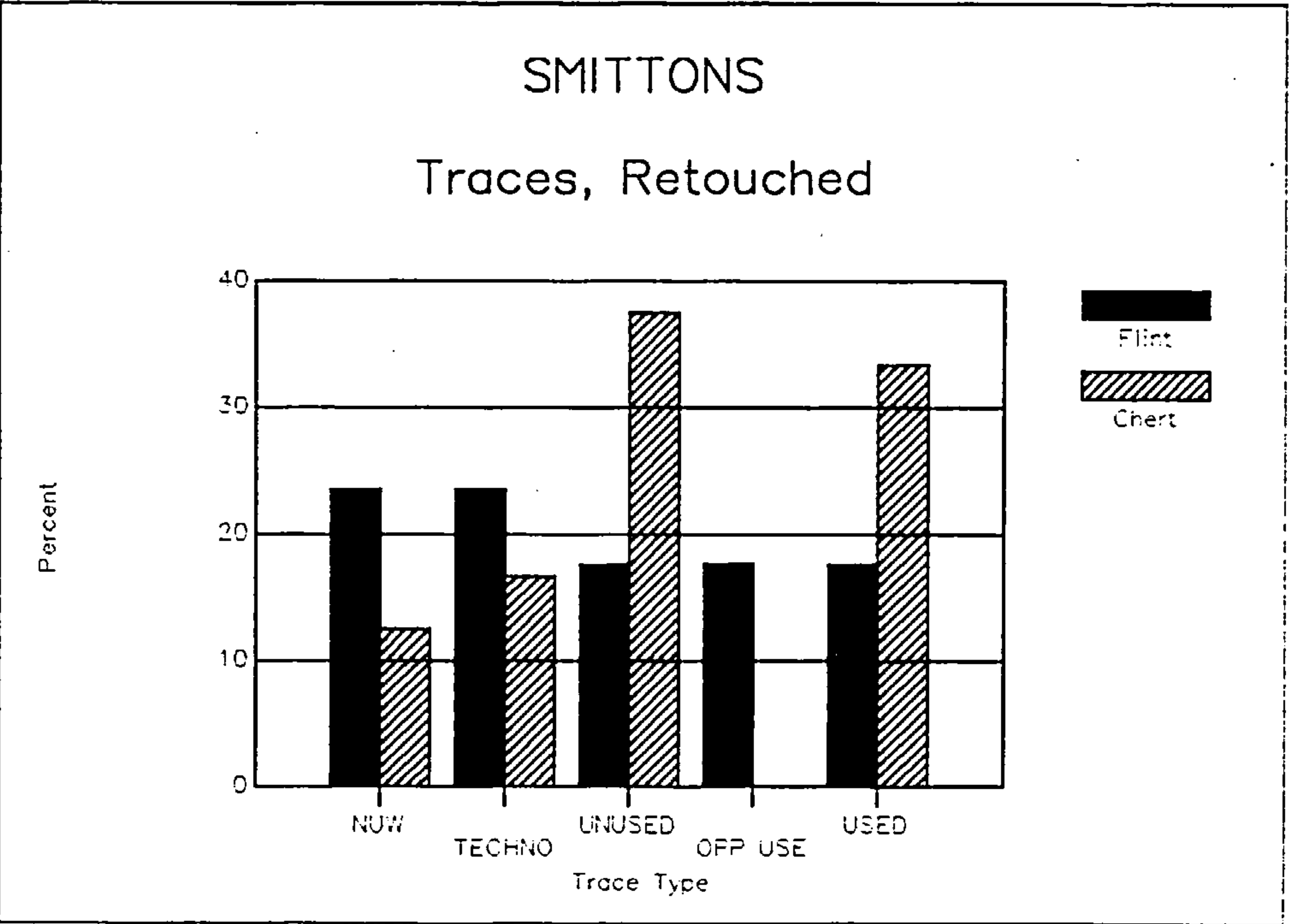


Fig 11.10c

being used for heavier tasks, which cause visible edge-damage on the utilised pieces.

The basic division of wear traces into motions shows a dominance of longitudinal motions, particularly if the bidirectional, piercing and impact traces are considered with this group, giving 54% of the sample (Fig 11.11).

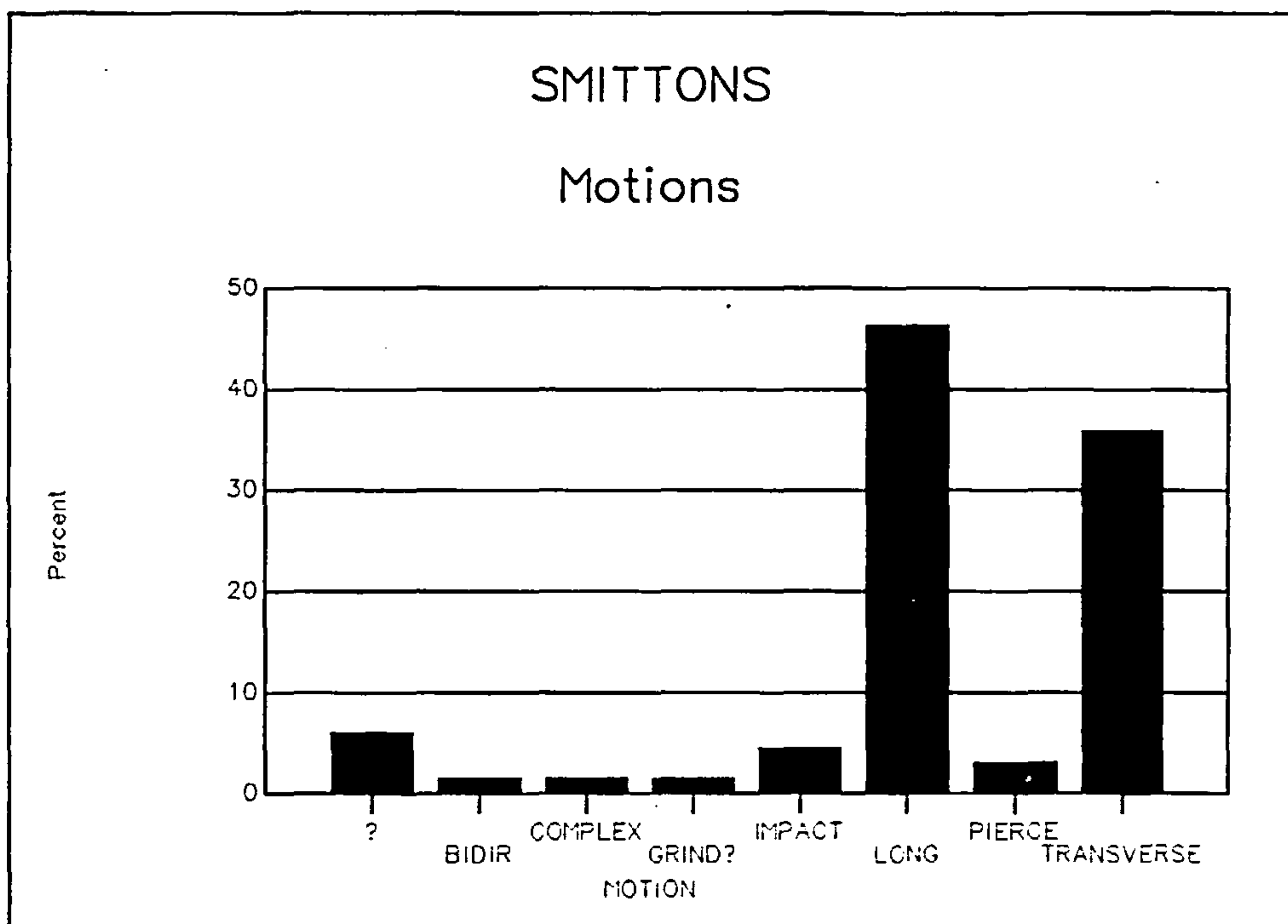


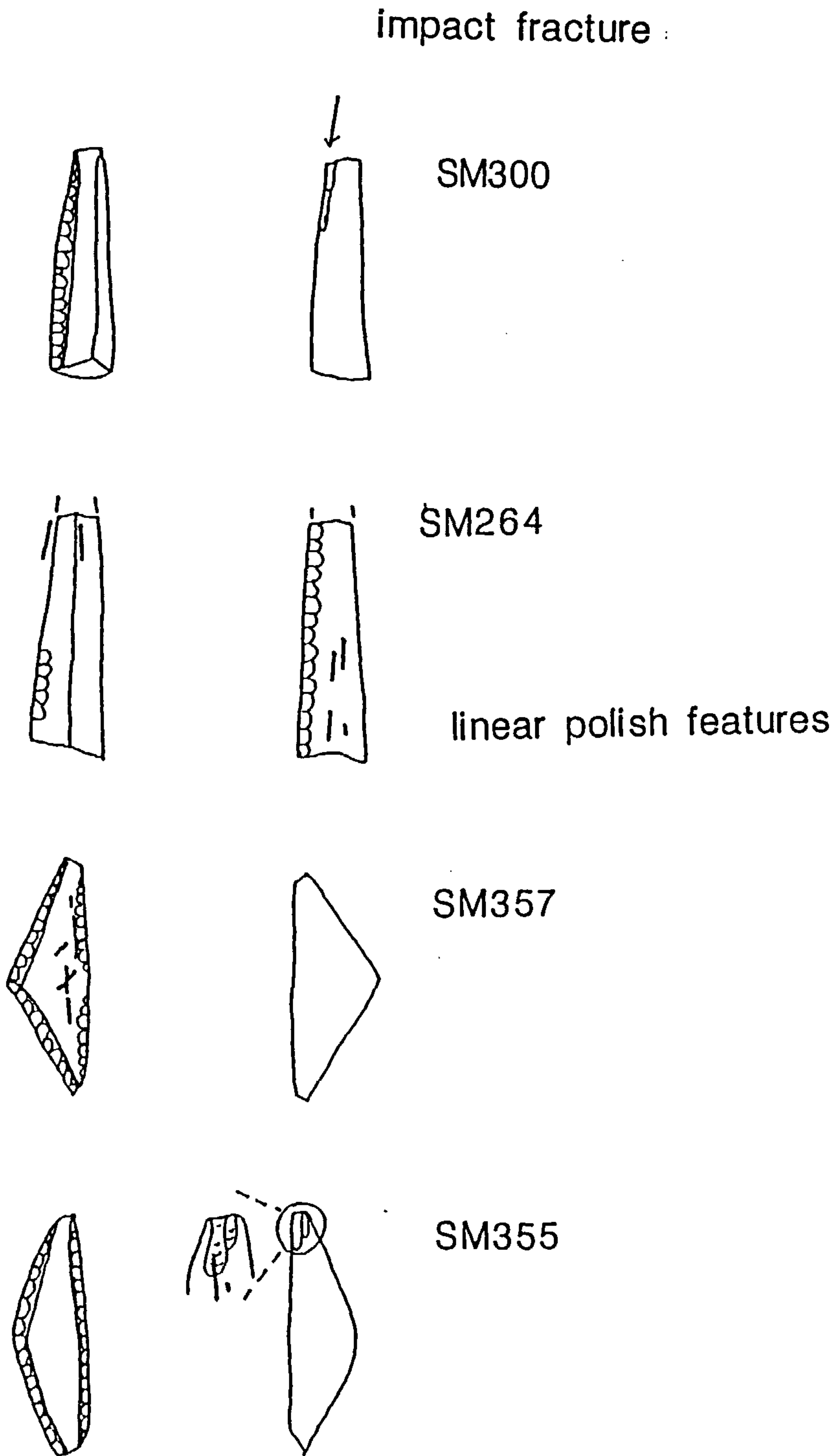
Fig 11.11

Motions of retouched pieces fall neatly into 4 transverse motions on scrapers, and 3 impact with 5 long motions on microliths. (All motions on opportunistic use retouch pieces were noted.)

Stage 3:

Probably the most significant detailed interpretation is the use of some of the microliths as projectile elements. The evidence for this consists of both long feather terminating fractures, initiated at the tips of pieces, and linear polishes, running over the tools parallel or at approximately 45° to the long axis (Fig 11.12). The linear polish features compare well with traces found on experimental pieces (Fischer *et al* 1974). The presence of some lines at 45° to the rest match traces explained

Fig 11.12 Diagram showing evidence for projectile use



as the result of the twisting of an arrow in its target with a subsequent change of trajectory (pers comm Peter Rasmussen).

The location of these features suggests use both as points and barbs. Six microliths have traces that suggest use as part of a projectile. Two of these pieces (scalene triangles) appear from the location of linear polish features, to have been barbs. The location and direction of the linear polishes suggest that the pieces were hafted with their unretouched edges exposed, the long axis of the tool parallel to the arrow shaft, and that the retouch served to help the hafting of the piece. Only three of the six pieces have clear traces, the other three have traces that are less easy to interpret, but fit the general interpretation as projectiles.

Two other microliths have very poorly developed traces, opposite their retouched edges, which led to their interpretation as "opportunistically used, long motion". Unfortunately the traces on these two pieces are too poorly developed to confirm or deny their use as projectile points.

Although only a few microliths have such traces, it has been noted that functional traces are not always produced by projectile use, so the number with traces must represent a minimum number (cf Fischer 1989). It is important to note that although there are few pieces with

Used Microliths			
N	Type	Motion	Interpretation
300	Backed	Impact	
355	Crescent	Impact	projectile
357	Scalene	Impact	projectile
18	Backed	Long	
22	Backed	Long	
264	Backed Frag	Long	projectile
364	Rod Frag	Long	projectile
369	Scalene	Long	projectile

Fig 11.13

positive evidence, and some with unclear traces, there is no evidence from this site which contradicts the interpretation of projectile use for microliths.

Conclusions:

It appears from the respective use-rates of flint and chert that the hypothesis that flint was brought to the site specifically because it had a higher functional value is incorrect. An alternative general hypothesis to explain the presence of the flint, and its different retouch rate has to be sought. The simplest explanation is that flint was easily obtained by the people involved, and that some material was transported casually, rather than carefully curated.

The fact that a higher proportion of the material is retouched presents no serious problem. As much of the flint was knapped elsewhere (presumably near the source), it is not surprising that there is less flint "waste" present than chert waste material. It is of course perfectly possible that all the flint microliths could have come onto site as one barbed arrow!

The flint assemblage corresponds to the patterns anticipated by Edmonds (1987) for a transient group whose immediate problems were the short term risks of the hunter-gatherer, rather than the long term risks of the farmer. He suggests that a high proportion of light and portable blades and microliths would be found, and that a high quality material would be used. However, the presence of the chert assemblage is directly contrary to this hypothesis, and the use rate of the flint is not the anticipated high use, with reworking and recycling.

The total sample from this site is small, which obviously places some limitations on any interpretation of the evidence. In particular, any attempt to isolate differences between the stratified samples is difficult. In general the assemblage appears very homogeneous, with the exception of the varying flint proportions. These last are based on such small samples that care has to be taken in any explanation. It is possible that it does indicate an increased understanding and subsequent use of the local material by incoming Mesolithic people (Affleck 1986), but more sites need to be investigated to support such a hypothesis. The homogeneity of the sample can be used to point to two main conclusions: 1) that the two occupation phases represent similar phenomena; and 2) that such a two-phase occupation would be very hard to distinguish on most Mesolithic surface sites.

The importance of the functional analysis to this site has been to demonstrate that apparent value differences between flint and chert are not necessarily clear-cut. The site location in an inland, upland area, the small size of the assemblage, and the predominance of microliths might all suggest that the site was a hunting camp. However, although the functional data includes evidence of missile use, it also includes evidence for a wide range of other activities, more than might be expected from the limited activities of a hunting camp.

12: Starr 1

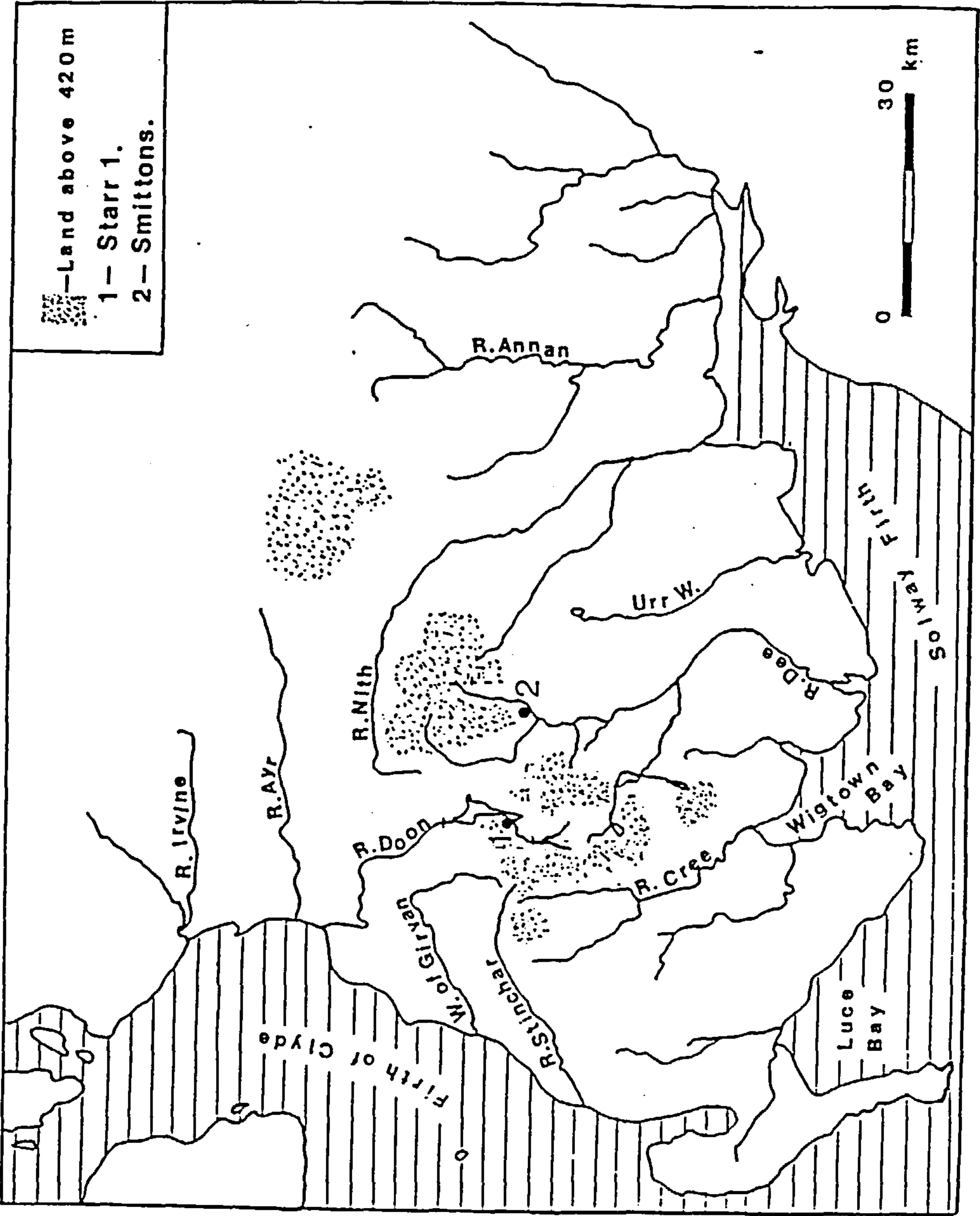
Site Description:

Starr 1 (Affleck 1986) lies on the shore of Loch Doon, in a location ideal for the notional Mesolithic Upland Hunting Station (NX 483939, c 300m OD, see Fig 12.1). A firespot has been dated to 6230 \pm 80 (OxA-1596). There are a number of other Mesolithic sites close by (Ansell 1966-1975, Affleck 1983-1984). The site appears to be part of a complex of Mesolithic lithic scatters. The site itself consists of a series of artifact scatters, and is almost certainly the result of more than one "occupation". The basic assemblage from Starr 1 is divided into a surface and an excavated sample. Whether *any* meaning can be attached to this division will be discussed below, but information will be presented on the samples as separate entities. Even if they do not reflect a Mesolithic phenomenon, they are the result of different recovery methods. The surface sample is gathered from several eroding horizons. There are problems with the analysis of surface-collected samples, as they often appear to have marked discrepancies with excavated material from the same site (Morrison 1982).

Within the assemblage one area (Trench 5) appears to have two *in situ* knapping spots, one cluster of chert cores and debitage, and a cluster of flint. Both elements are reported to have occurred on the same soil horizon. (Affleck 1986)

This assemblage poses severe problems for sampling. It probably consists of a number of disparate elements but it is impossible to separate their components. The number of different events and their time span is unclear. It cannot be stated that all occupations were of a similar nature. Such elements that do appear to represent single events (for example the "knapping locale") may be mixed with earlier and later material. Even if they are assumed to be unmixed, taken individually these samples are too small for analysis. Affleck suggested that the surface sample may represent the most recent occupations, and that the excavated sample represents the earliest occupations. Although

Fig 12.1 Location map of Starr1



this hypothesis probably conflates and over-simplifies the site history, the two samples have been analysed separately as coarse-grained units.

Raw Material:

At Loch Doon, as at Smittons, the raw material used for chipped stone tools is a combination of flint (48%) and chert (52%). The chert occurs immediately around the sites, and is available in large quantities. The flint is, as at Smittons, beach pebble flint. The high proportions of flint primary and secondary flakes (fig 12.2) reflect this use of a small pebble source. As such they do not necessarily indicate a major functional difference in intention from the chert, but are possibly the result of different reduction strategies on different materials with the intention of producing the same end result. The chert does not always have clear evidence of its exterior surface, and figures for primary and secondary chert flakes therefore represent minimum values.

Fig 12.2 shows the basic divisions of the assemblage if all the material is considered as one sample. The sample divided into surface and excavated material is shown in fig 12.3. There is an obvious difference in the rate of flint use between the two samples. Affleck suggested that the earlier Mesolithic visitors may not have appreciated the suitability of the local chert for knapping, and imported more flint with them. The presence of chert in the excavated sample is however quite high. This may be the result of the conflation of several occupations, each one using a higher proportion of the local material. This hypothesis of increasing chert use is supported by the higher incidence of chert in the Upper unit at Smittons. Flint is generally more common in the Starr assemblage, despite the increased local availability of chert.

Affleck also noted that the surface sample may be biased by other factors. The higher visibility of the lighter coloured flint on the surface in an area that has been field-walked for some years could have resulted in a disproportionate loss of flint. The main collector (Ansell) is an experienced field-walker, but it is a fact that the stony ground surface causes observation problems, particularly with small pieces.

Chert and Flint, both samples				
	Chert		Flint	
Flakes:	N	%	N	%
Inner Irregular	182	16	155	14
Inner Regular	132	12	111	10
Secondary	67	6	122	11
Primary	11	1	24	2
Total	392	35	412	37
Blades	63	6	91	8
Chunks	83	7	18	2
Cores	47	4	14	1
Total	587	52	536	48

Fig 12.2

Overall the small sample sizes from these sites suggest that at present hypotheses to explain the apparent shift in material exploitation should be made with caution.

Technology:

Fig 12.3 shows the basic division of the assemblage. Overall the proportion of blades is lower than at

Flint and Chert, separate samples								
	surface				excavated			
	Chert		Flint		Chert		Flint	
Flakes:	N	%	N	%	N	%	N	%
I I	63	24	7	3	119	14	148	17
I R	42	16	15	6	90	10	96	11
Secondary	32	12	10	4	35	4	112	13
Primary	4	2	5	2	7	1	19	2
Total	141	53	37	14	251	29	375	44
Blades	22	8	14	5	41	5	77	9
Chunks	27	10	4	2	56	7	14	2
Cores	18	7	1	0	29	3	13	2
Total	208	79	56	21	379	44	480	56

Fig 12.3

Smittons. The majority of blades are made of flint, of which material they form 17%, compared to only 10.5% for chert. The overall blade proportion is 13.5%.

The distribution of cores (fig 12.4) shows a preponderance of chert cores. There are over twice as many chert cores as flint cores in the excavated sample. In total there are more than three times as many chert cores as flint cores, however an analysis of core types reduces this disparity, as the flint cores are more heavily worked.

Starr 1 Cores						
	All		Surface		Excavated	
	Ch	F	Ch	F	Ch	F
Platform :	27	9	9	1	18	8
Amorphous:	15	3	7		8	3
Scalar :	2	1				1
Nat Blank:	17		7		10)	
Blade :			3		7	4
Flake :			10		12	5
Mixed :			5	1	7	3

Fig 12.4

A figure is given for "Nat Blank". This refers to those chert cores that are based on a natural chert lump. Because of bedding flaws in the chert, there is a tendency for chert pebbles to reduce to rhomboid shapes. This does provide a natural striking platform on many of the pebbles, but these pebbles are not reduced to the same degree as the manufactured cores, many having less than 6 removals. There is a 3:1 ratio of chert platform cores to flint platform cores, but flint cores tend to have a higher number of platforms. The ratio of chert to flint platforms is 2.5:1.

An examination of the final removals visible was also made. Cores were described as blade or flake after the majority of visible final removals, a mixed category was used for those that fell into neither group. On the whole blade cores were more extensively scarred than flake cores, and again the proportions of flint to chert are higher for blade cores, again suggesting the more intensive use of flint cores.

Apparently the material on site only represents a part of the chert reduction sequence, as Affleck recorded that at Starr 3 "roughly broken pieces of 8cm in width are common". The explanation given for this is that prior to the production of usable pieces of chert there was an initial step where chert lumps were broken up to find relatively flaw-free pieces. At Starr 1 there is no evidence for this step, but most of the chert collected is of reasonable quality, and has obviously been at least pre-sorted, if not partially knapped, before being brought to the site.

Given the differences between the two raw materials, it is perhaps unwise to draw too many conclusions from the proportions of material from the initial knapping stages. The more wasteful approach necessitated by the chert inevitably means that chert cores are liable to be more common than flint wherever a significant amount of this chert is used.

Typology:

There are few classifiable retouched tools from Starr1. They comprise a small number of scrapers and some microliths (Fig 12.5). Also listed are the edge-damaged pieces. It is clear from the examination of the retouched pieces that flint, as at Smittons, was disproportionately popular (Fig 12.6).

Starr 1 Retouch						
	Chert			Flint		
	All	Sur	Not	All	Sur	Not
No Retouch :	533	198	335	471	46	425
Edge-Damaged:	36	8	28	39	9	30
Retouched :	16	2	14	25	1	24
Microliths :	10		10	17		17
Scrapers :	6	2	4	6	1	5
Other Retouched:				2		2

Fig 12.5

Starr 1 Retouch as percent per sample						
	Chert			Flint		
	All	Sur	Not	All	Sur	Not
No Retouch :	53	81	44	47	19	56
Edge Damaged:	48	47	48	52	53	52
Retouched :	39	67	37	61	33	63
Microliths :	37		37	63		63
Scrapers :	50	67	44	50	33	56
Other Retouched:				100		100

Fig 12.6

The microliths are divided into seven types (Fig 12.7). Of these the oblique truncations include one atypical piece (S1 361). The 'point' is broken, and therefore possibly misidentified. Flint dominates the overall total, but in particular the more complex types. The simplest type, the backed bladelet, is only represented by chert pieces. This is contrary to the situation at Smittons.

Microliths			
	All	F	C
Scalene Triangles:	10	5	5
Crescent :	2	2	0
Point :	1	1	0
Frag :	6	5	1
Backed :	3	0	3
Oblique Trunc :	4	3	1
Trapeze :	1	1	0
	27	17	10

Fig 12.7

The range of microliths present is not the same as at Smittons, where microliths consisted almost entirely of backed bladelets and scalene triangles. Whether this difference implies a chronological or functional distinction will be discussed below.

Functional Analysis:

Sampling:

For the purposes of the functional study it was decided to concentrate on the excavated material to reduce the numbers of pieces from disturbed and exposed contexts, although much of the surface collection had apparently only recently eroded. Although it is possible that occupation of the site varied in function, all material was considered as being from a similar *type* of occupation. Occupations were always small scale. A total of 168 pieces were examined.

Analysis:

Stage 1:

Nine pieces were removed from the sample, seven due to extreme burning or weathering effects, and two as a result of traces that could not be interpreted. A high proportion of pieces had traces indicating use (Fig 12.8), with a very high proportion of pieces with Non-Use-Wear traces (19%). As Non-Use-Wear traces may be the result of post-depositional disturbance, this figure is disturbing, as it represents a high proportion of pieces that may have use traces obscured. In addition, as the NUW proportion is so high, interpretation of all the visible traces should be approached with extreme caution.

When the materials are examined separately, it is immediately apparent that flint has a very high use rate compared to chert. In addition there is a marked difference between the proportions of pieces with NUW traces. This suggests that the high rate of chert NUW must have a particular explanation (the flint NUW rate is within the normal range for the other samples examined). One possibility is related to the difficulty of always recognising the exterior surface of a chert pebble. The

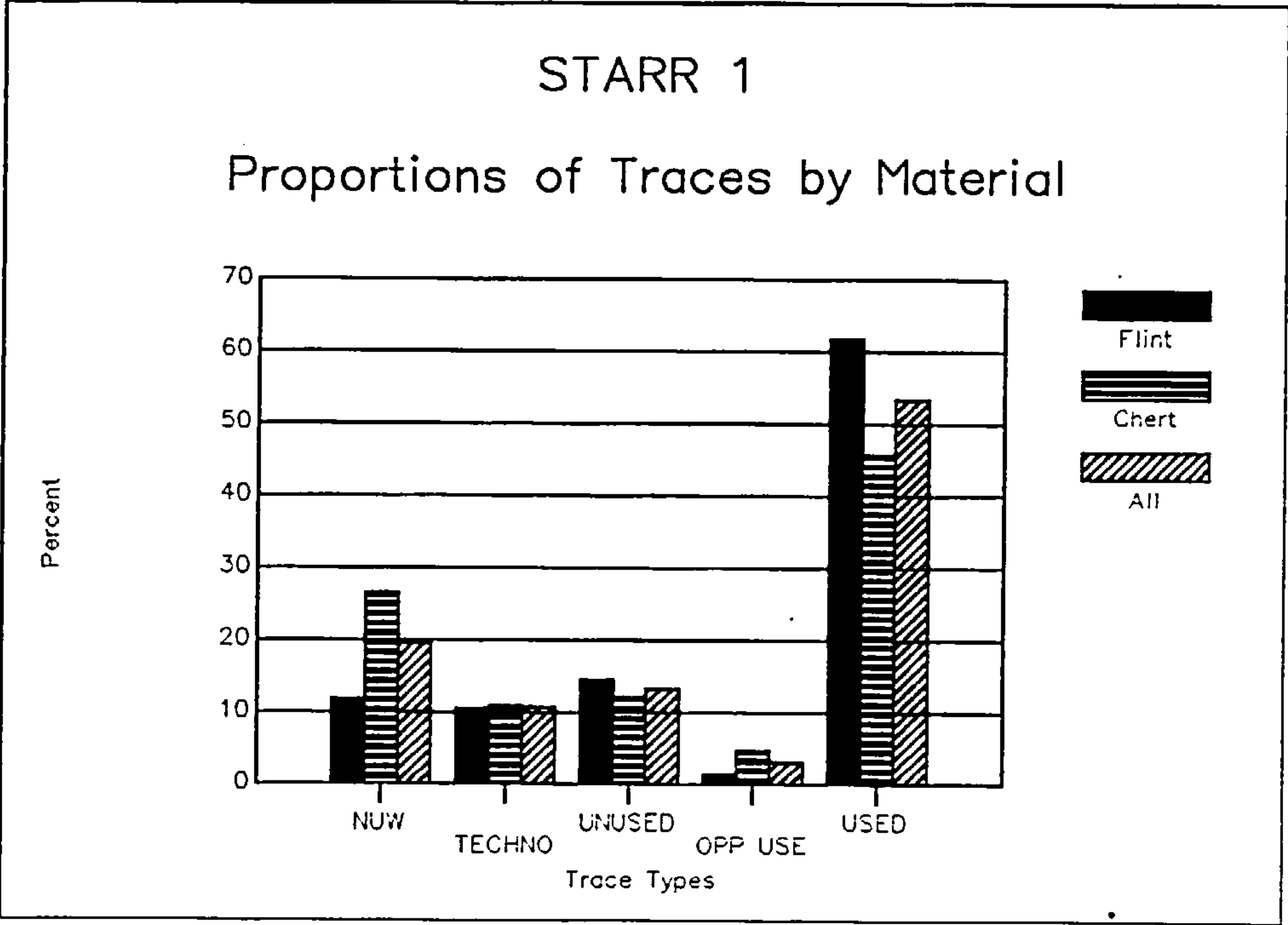


Fig 12.8

more recently broken pebbles have surfaces that look very similar to the interior faces of knapped material and not like the weathered surface of older pebbles. On simple visual inspection they appear identical, but under a microscope and in terms of NUW there is a major difference; the recently broken chert pebbles have been exposed, slid down scree slopes, etc. Such surfaces may be expected to present a higher incidence of NUW.

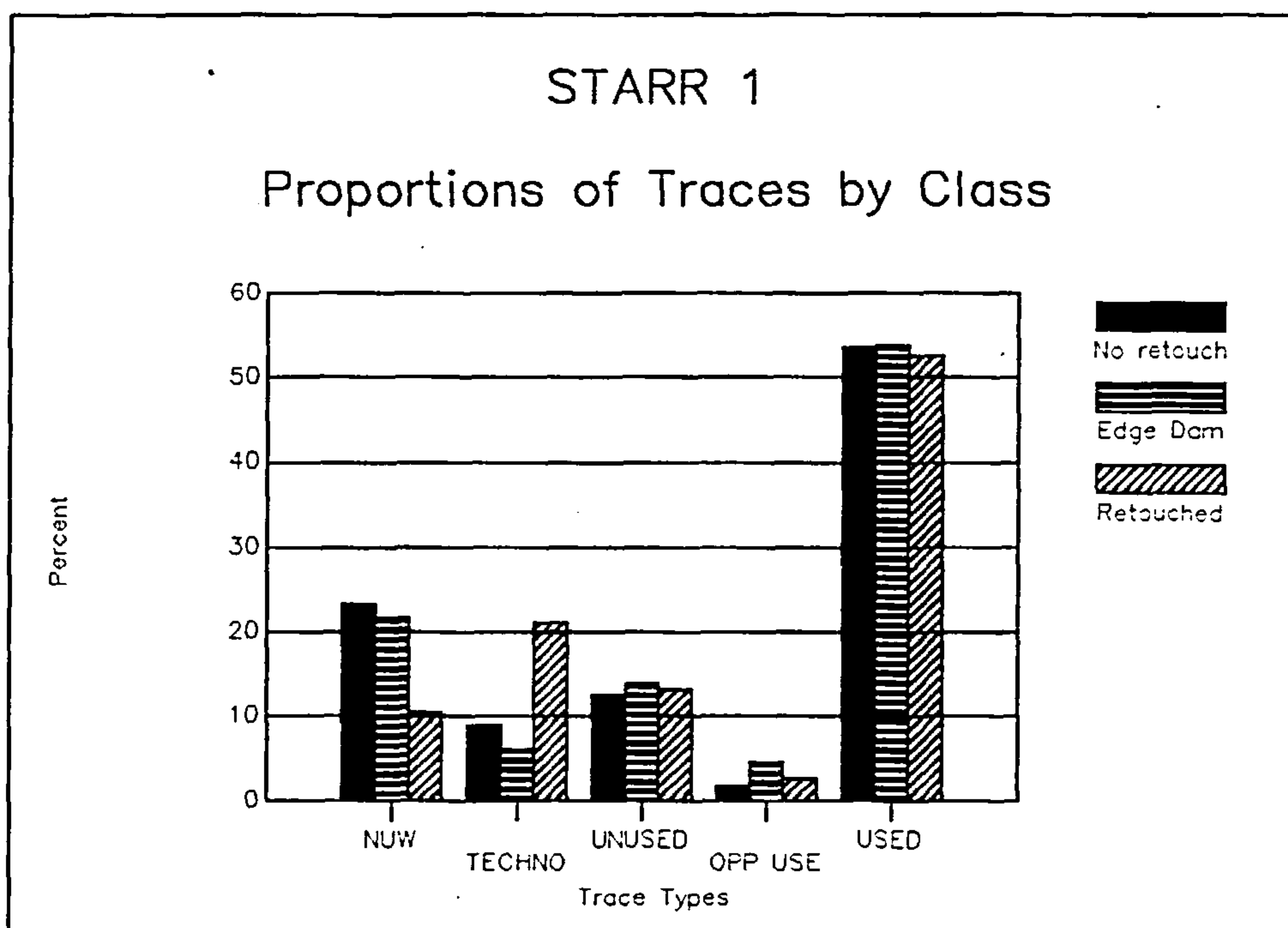


Fig 12.9

Stage 2:

An examination of the sample divided into unretouched, edge-damage and retouched pieces (fig 12.9) suggests that at this site such a division is not a useful way of predicting wear traces. All the used rates are very similar (52, 53, 54%). In fact, if the cores are removed from the no retouch group, the use rate of that group rises to 66.6%. The main difference between the three classes is the high incidence of "techno" features on the retouched pieces. This is not surprising, as many of these features are the result of secondary modification processes.

Analysis of trace types by material and the above categories (fig 12.10a-c) demonstrates even more clearly the relative importance of flint at this site. In the retouched category, not only is the chert overall use rate lower than the flint, but the chert includes opportunistically (or marginally) used pieces, while the flint has none. The same occurs with the unretouched pieces of flint. There is a small group of opportunistically used edge-damaged flint pieces but they are less than half as frequent as chert opportunistically used edge-damaged pieces.

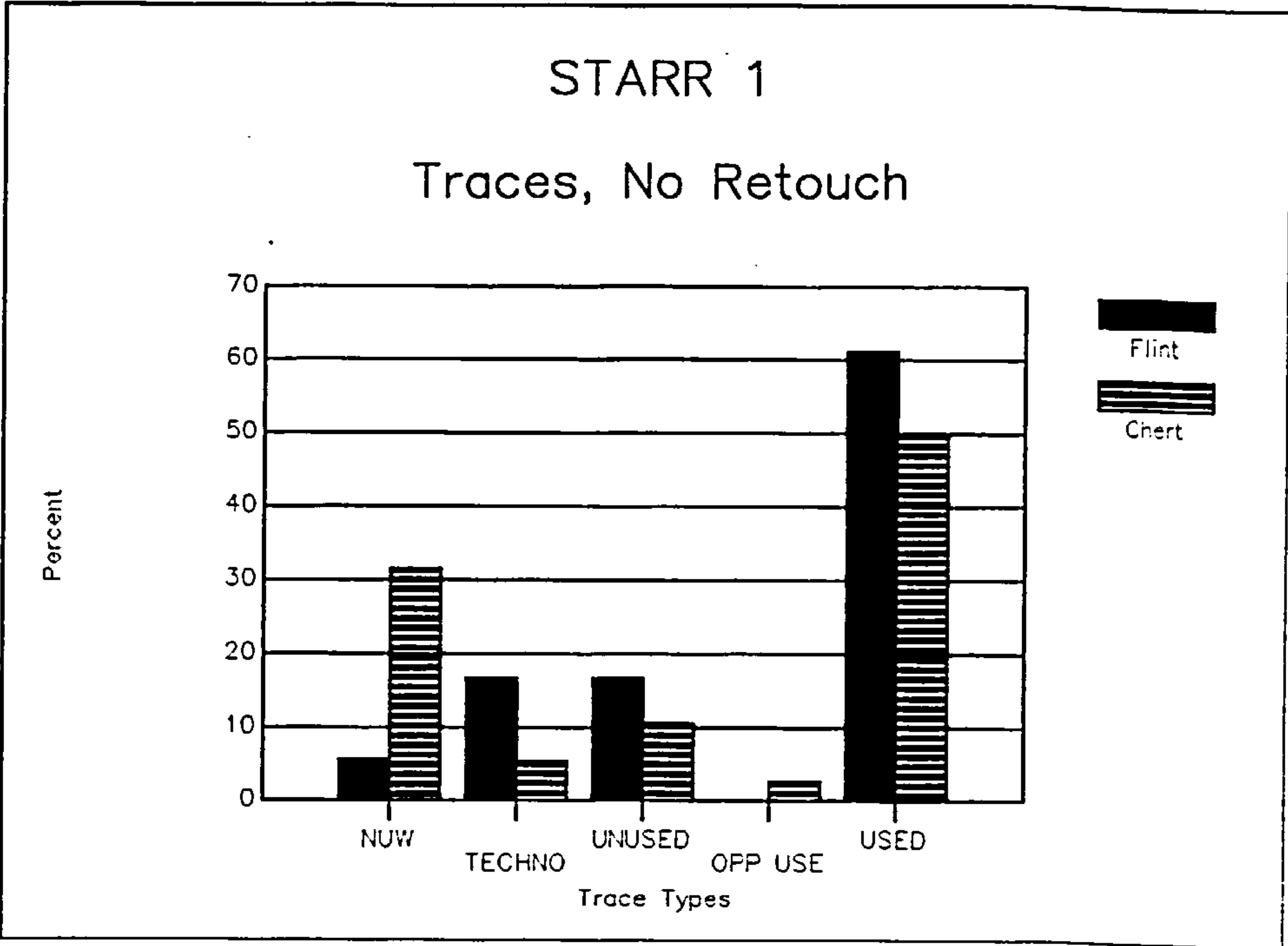


Fig 12.10a

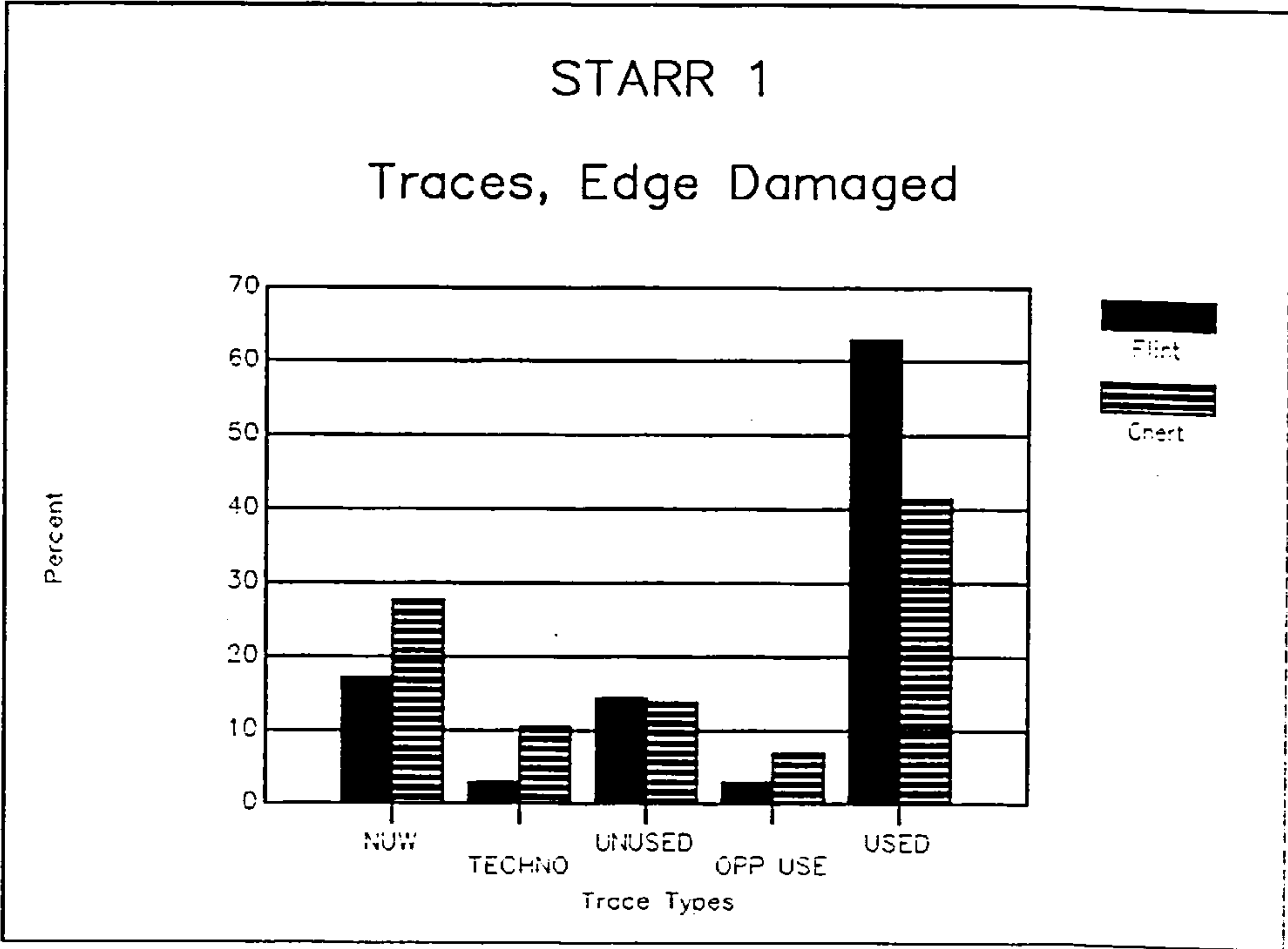


Fig 12.10b

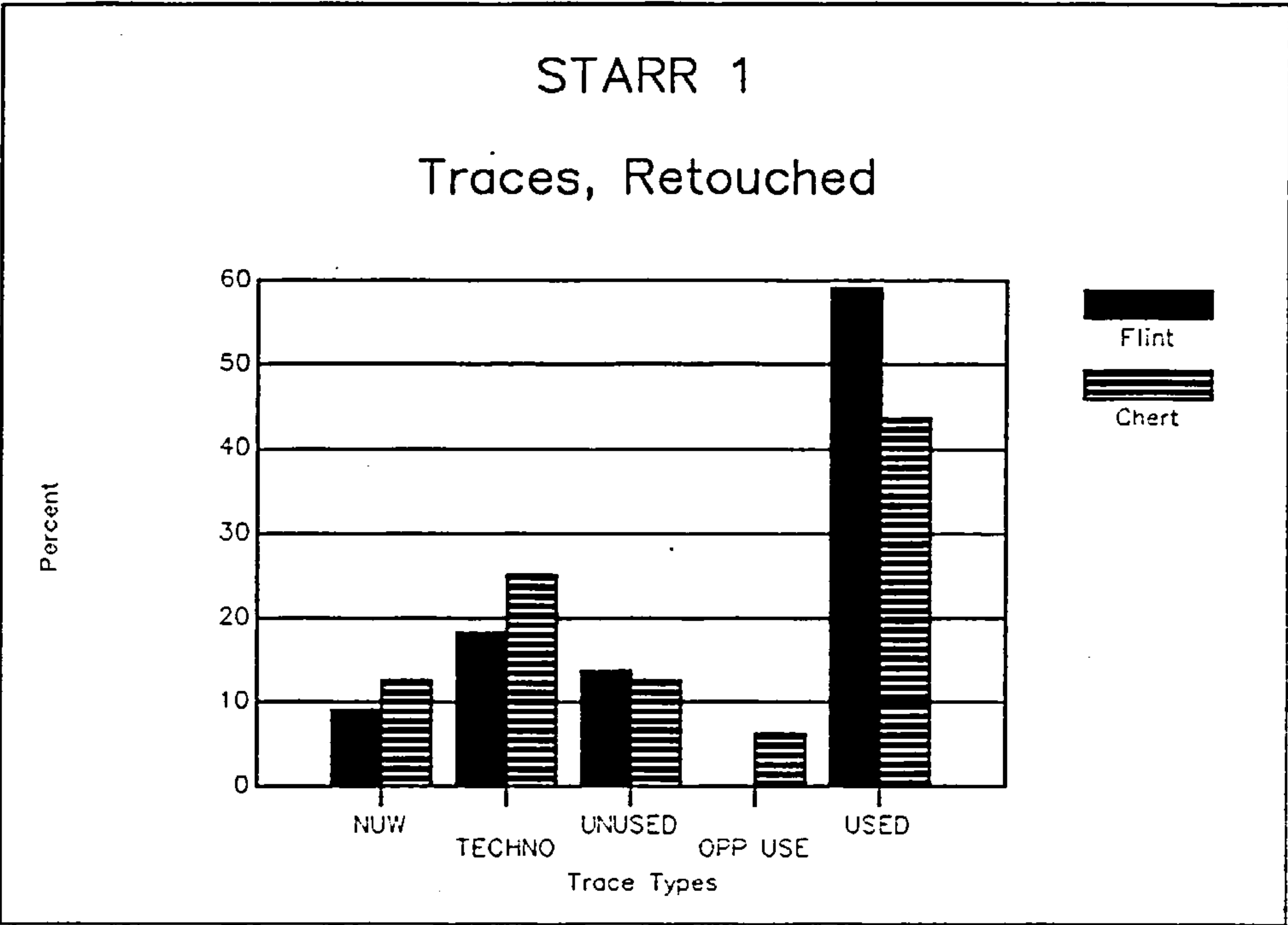


Fig 12.10c

The separation of the wear traces into distinct motions shows an interesting pattern (Fig 12.11). Motions cannot be diagnosed for 6% of the used pieces. The remainder of

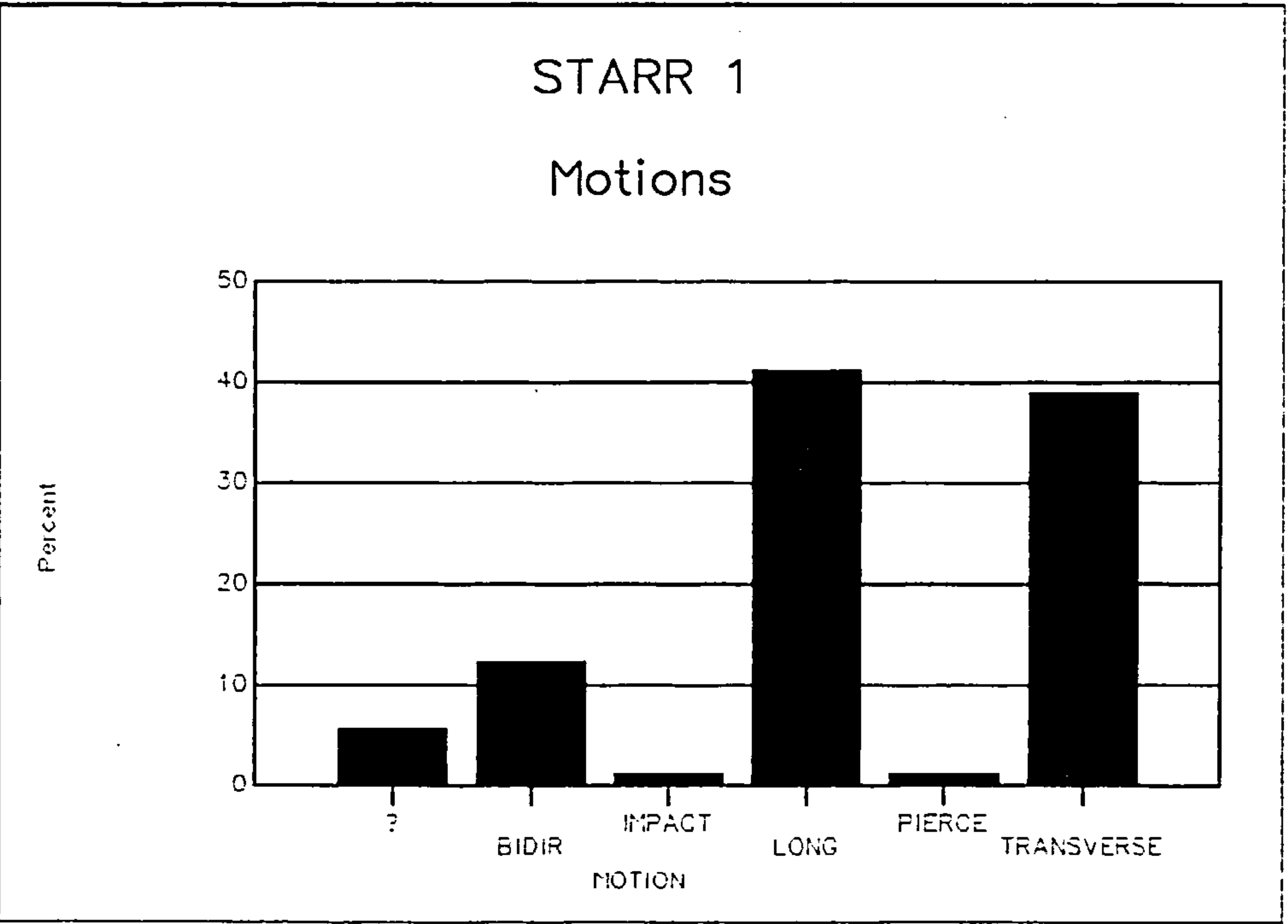


Fig 12.11

the material is divided into two roughly equal units of long and transverse, but with a large number of pieces exhibiting features indicating bidirectional longitudinal motions.

The separation of the used pieces into flint and chert again reveals an interesting pattern. More than half the flint pieces have evidence for long or bidirectional motions (fig 12.12). The chert remains more balanced, but with transverse motions becoming more significant. From the evidence of the experimental programme conducted a likely explanation for this differentiation can be found in the nature of the two materials. Because of the flaws and irregularities in the chert it is more difficult to obtain strong, straight, long, sharp edges, than in the flint. On the other hand both materials equally easily produce the thicker chunkier pieces frequently useful in transverse actions such as scraping.

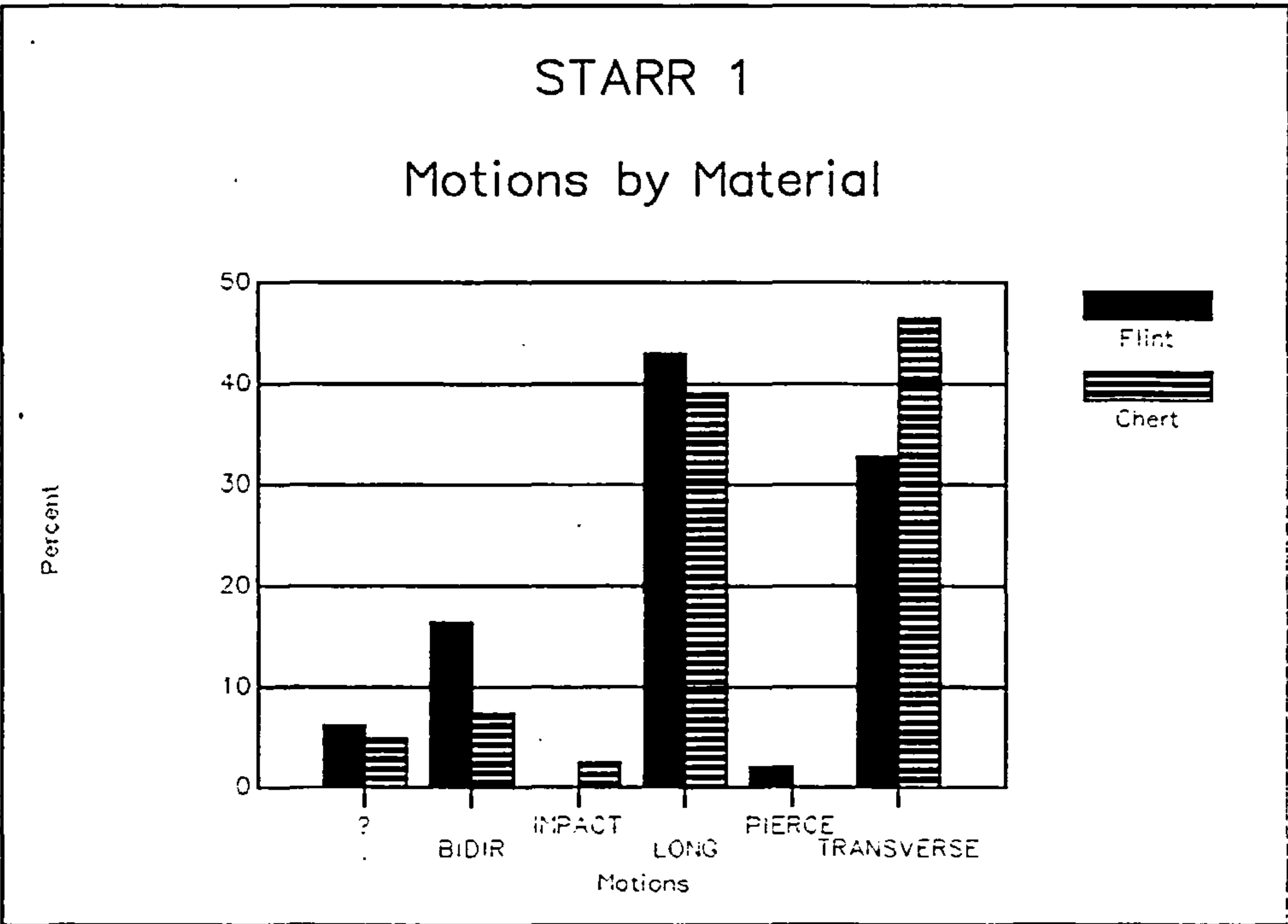
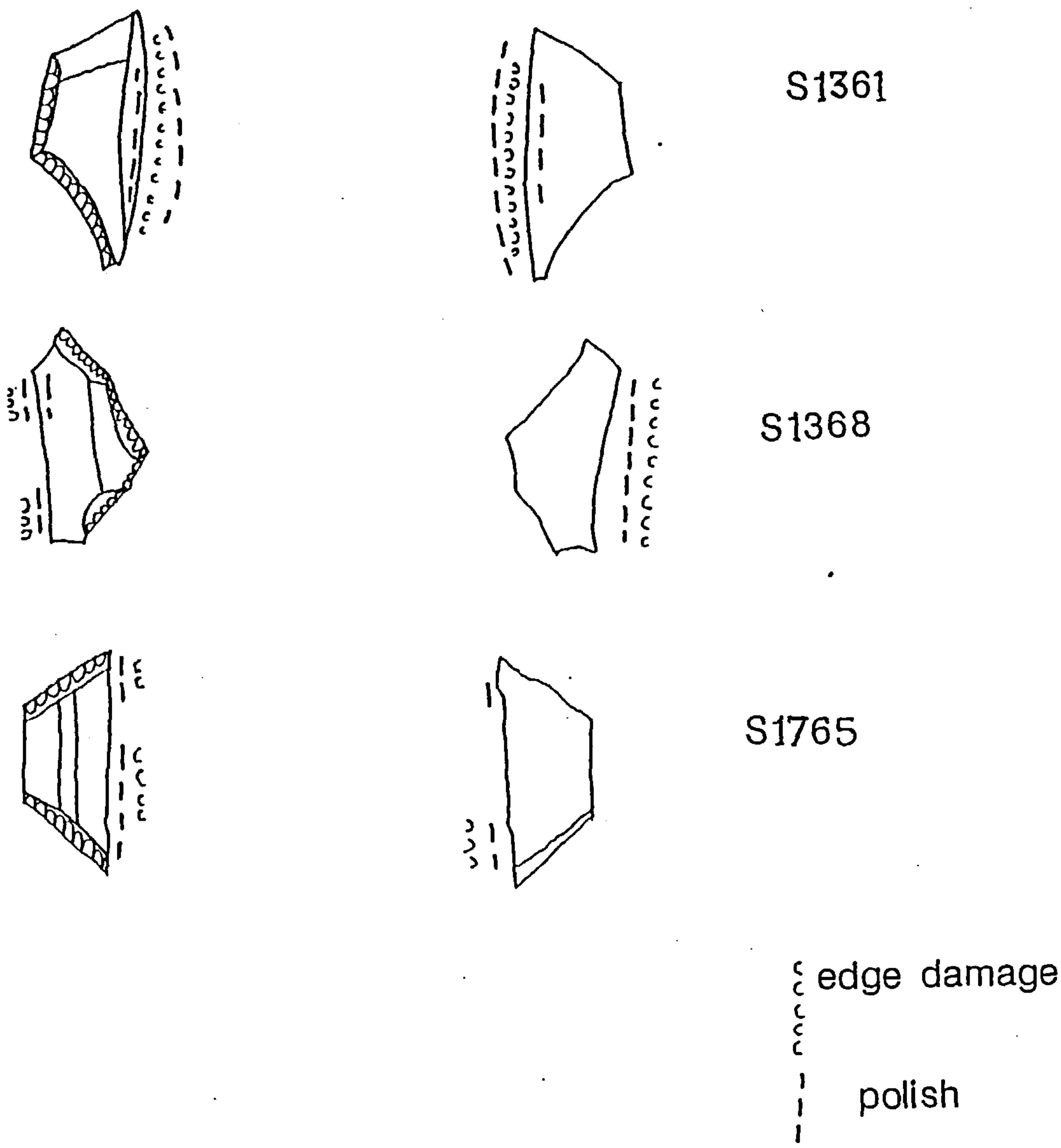


Fig 12.12

An examination of the retouched pieces against motion shows that with scrapers there is a high correlation with transverse motions (8 out of 9), but that microliths do not exhibit the same pattern as at Smittons. At Starr 1 there is no good evidence for use as projectile parts. There is instead a strong indication that microliths were used for non-missile activities. One microlith has

Fig 12.13 Microliths with evidence for non-projectile use



evidence suggesting a transverse motion, but most interesting are three microliths that have evidence indicative of a bidirectional longitudinal motion (Fig 12.13). Four more microliths have evidence of longitudinal motions, unspecific to bidirectionality, but not like projectile traces. One microlith has evidence of use for piercing, and two have undiagnostic traces (fig 12.14).

Microlith Use			
N	Type	Motion	Interpretation
366	scalene	?	complex
835	oblique trunc	?	
361	oblique trunc	bidir	saw
368	scalene	bidir	saw
765	trapeze	bidir	saw
367	scalene	long	
371	crescent	long	cut
778	scalene	long	
988	frag	long	groove
755	frag	pierce	
754	scalene	transverse	shave

Fig 12.14

Stage 3:

This evidence for motion goes contrary to all assumptions that microliths represent barbs and points for arrows for hunting. It is therefore essential that the evidence for such a case should be very good. It can be argued that if the evidence for bidirectional motions is good, then the case is demonstrated that not all microliths are armatures. This evidence will therefore be presented in detail.

S1 361: Flint microlith, atypical oblique truncation. Traces are on the long, acute, slightly convex, unretouched edge. They run continuously on both dorsal and ventral faces along most of that edge, except for the two ends.

Edge Damage: Virtually identical on both faces. Clustered frequent deep mostly feather terminating scars, mostly small to minute. Occasional snap fractures on the ventral surface. No rounding. Scars are initiated in both directions, very clearly.

Polish: Very similar patterns on both faces. Ventral face slightly less polished than dorsal. On extreme edge a narrow polished bevel along sinuous scarred edge. On both faces polish spread, penetrating onto the surface. Generally linear development along edges. Polish smooth, varying from flat allover to domed reticulated.

Striations: Run parallel to edge in polish on dorsal face.

Interpretation: All the differences between dorsal and ventral can be explained by the different morphology of the two faces. All the features, bifacial wear, parallel striations, parallel linear development of polish, suggest a longitudinal motion. The initiation of scarring suggests a bidirectional motion. Edge damage and polish distribution suggest a medium hard material worked, possibly wood.

S1 368: Flint Microlith: Traces are on the long, straight, acute, slightly convex/concave, unretouched edge. They run semi-continuously along both dorsal and ventral faces.

Edge Damage: Identical on both faces, except for frequency, common on ventral, occasional on dorsal, clustered, mostly shallow, mostly feather terminating medium to small scars. No rounding or snap fractures. Scars appear to be initiated in both directions.

Polish: Very similar patterns on both faces. On both faces polish penetrates onto surface. Particularly on dorsal polish in overall linear pattern, parallel to edge. Polish smooth, patchy, invasive into microtopography. (One flat bright spot adjacent to retouch.)

No striations.

Interpretation: Features all convincingly suggest a longitudinal motion, bidirectionality probable, but less sure. Light, shallow, feather

terminating edge damage and invasive polish suggest a medium soft material worked.

S1 765: Flint Microlith, trapeze: Traces are on long, straight, acute, unretouched edge. Traces run semi-continuously on dorsal face, and for 33% of ventral face.

Edge Damage: Where they occur, identical on both faces. Clustered, frequent, deep, mostly step terminating scars, varying from medium to large. No rounding or snap fractures. Scars are initiated in both directions, clearly.

Polish: Polish mainly identical on both faces, penetrates onto surfaces, smooth, patchy, flat. General linear development along edges.

Striations: Numerous striations in polish on ventral surface, running parallel to edge.

Interpretation: Long motion clear, scarring clearly suggests bidirectional. Edge damage and polish suggest a medium hard material, possibly wood.

While the bidirectional nature of the motion, and the description of the materials worked, might be disputed, it should be clear that these traces result from a continuous longitudinal use, and cannot be explained as projectile use traces. The nature of the traces suggests that the retouch on the microliths is for prehension (probably in the form of a haft, as they are very small to utilise hand-held). The dominance of long motions in general on the Starr microliths suggests that this is not the incidental use of the side of an arrow as a knife. The patterns of traces are not all identical, suggesting they were used as parts of separate tools on different materials.

This discovery has several important implications for the Mesolithic. Firstly, it means that the equation: microliths = hunting, can no longer be assumed. From this it follows that Myers' arguments concerning

changing patterns of hunting are more problematic. Secondly, it means that as microliths appear not to relate simply to one function, their role as stylistic markers is likely to be complex. Interpretations involving their use as simple indicators of stylistic change have to be made with caution. They have a multiple functional dimension too. It is dangerous to build up inferences when it is not known what the basic building blocks are.

There is a degree of use of cores at Starr 1 that is not found at Smittons. Eight cores have various traces on them (fig 12.15). Cores are a very difficult class to work with, as they frequently have numerous features produced during knapping.

Cores				
N	Type	Mat	Motion	Interpretation
196	Bipolar	C	Long	cut med
399	Rejuve	C	Long	groove med s
505	Platform	F	Transverse	scrape
856	Platform	C	Transverse	? scrape med
875	Amorphous	C	Impact	? hammer
877	Platform	C	Long	? cut med h
899	Amorphous	C	Transverse	? scrape med
918	Platform	F	Transverse	scrape med s

Fig 12.15

The uncertainty of interpretation is reflected by the four (?) pieces. Piece S1 399 is not a core, but a core rejuvenation flake, included to demonstrate that even such technically "waste" pieces can still be functionally valuable. It should be noted that of the four uncertain pieces, all are chert. There is no doubt concerning the use of the flint cores.

There is evidence from this small group of cores that in some cases small platform cores may be used as scrapers. While the designation "core-scraper" should still be avoided in typological classification, it is clear that cores need not be regarded as a non-functional category. This has already been noted by Dumont (1985: 445) at Starr Carr, where some

cores were interpreted as having been used as wedges. At Smittons only one core was apparently used, difficult to interpret, but possibly as a grinding stone (pestle).

Conclusion:

The patterns emerging from Starr 1 are not the same as for Smittons.

- 1) There is a difference in use rates between flint and chert.
- 2) There is in general a higher incidence of use of pieces at Starr 1
- 3) The suggested functions for microliths at the two sites are dramatically different.

The overall different use rates imply a difference in function. Despite the larger overall sample of lithics from Starr 1, it is suggested that this sample is composed of more occupations than that at Smittons, and that in terms of lithic remains, those occupations were smaller. It should not, therefore be surprising that a functional difference can be observed. What precisely that difference was remains at present a matter for speculation.

An important point to note is that the microliths from Starr 1 are *typologically* different from those at Smittons. It seems possible that the functional difference observed between the two sets of microliths could be explained by this. If so, this represents another unsuspected difference in microliths, that microlith morphology represents a **major** functional differentiation.

What is clear from both sites is that neither of them represent in a simplistic fashion "hunting camps" where little besides field maintenance of equipment occurred. Indeed Starr, the more upland of the two sites has less evidence for this function than Smittons. There are no apparent traces of archery, and scraping tools have been used to scrape (supposedly a base camp function). The immediate environment of the site may provide an explanation for this, with good fishing and foraging readily available around Loch Doon, it should act as a reminder that inland and upland do not just mean red deer hunting.

13: Gleann Mor

This case study represents the preliminary analysis of a small sample of lithics from the 1988 fieldwork season at Gleann Mor. Further work is planned on material from the 1989 season and the planned 1990 season. All figures given relate only to the 1988 fieldwork, and as such are now of limited value, as the 1988 total sample was only 4290, while pieces catalogued for 1989 already stand at 6991 and cataloguing is not yet complete. In effect this case study represents an interim report.

The site at Gleann Mor is part of the Southern Hebrides Mesolithic Project, designed to fill in the gaps in the Mesolithic distribution, and to enable the study of regional patterns (Mithen 1988). It is hoped that detailed lithic analysis will provide information on those patterns.

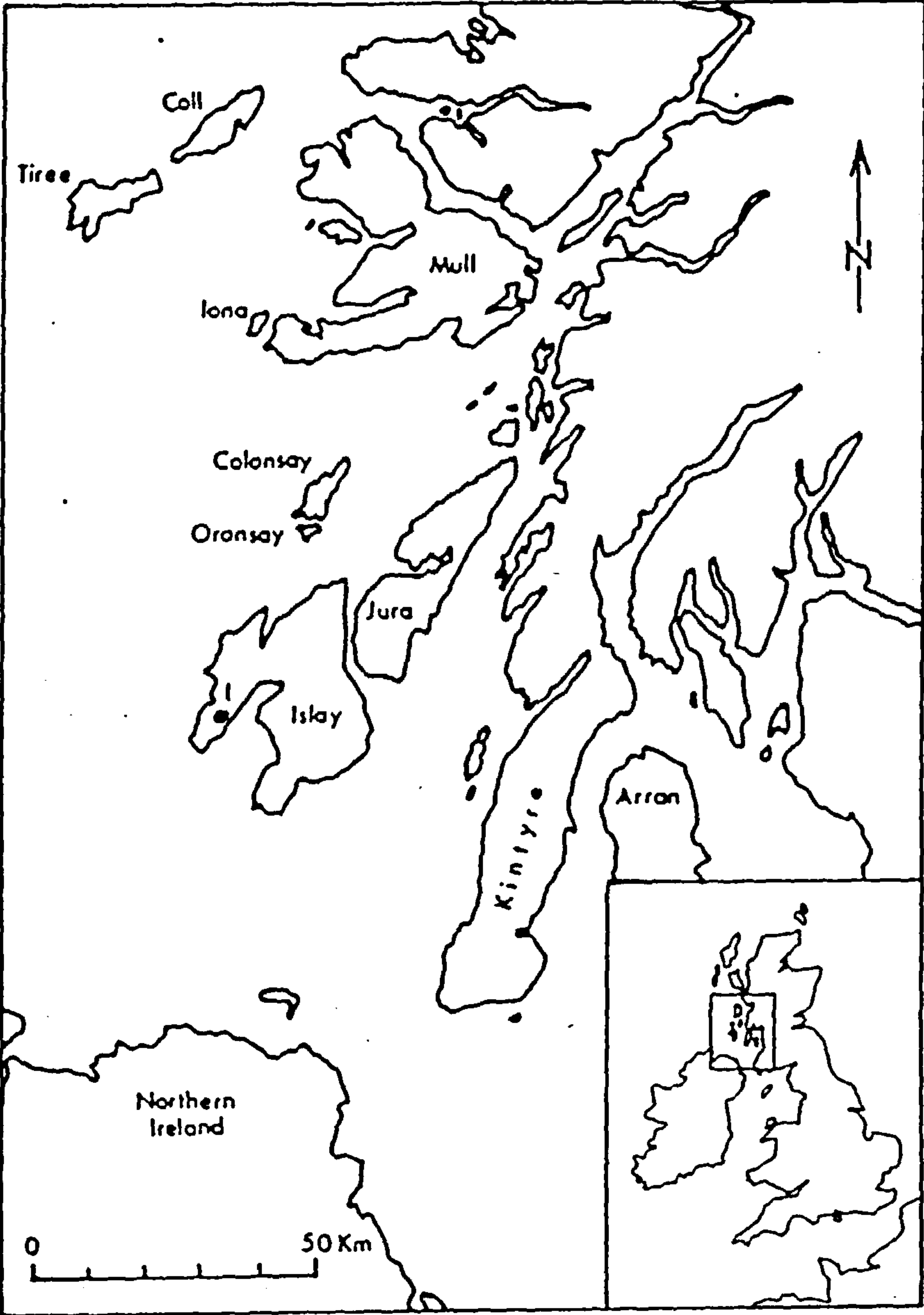
Site description:

Gleann Mor (GR 233582, 65m OD, fig 13.1) consists of a very small, dense flint scatter, lying below peat with a 5cm thick horizontal distribution. The site is about 10 minutes walk from the current shoreline. It was first revealed by erosion at the edge of an old sand quarry, and a more detailed examination began with the excavation of a series of test pits, followed by the small scale excavation of the densest part of the scatter (Mithen 1988).

Raw material:

On Islay there was apparently a plentiful supply of flint for the Mesolithic population. There are offshore marine deposits of flint, from which typical beach pebble flint is derived and also very 'fresh' large nodules. Presumably derived from this is some drift formation flint on dry land (Finlayson and Sinclair nd). This abundant, or relatively abundant supply of flint may have had a significant impact on not only the local reduction

Fig 13.1 Location map for Gleann Mor



1 = Gleann Mor

methods used, but also with regard to the utilisation of flint pieces.

The lithic assemblage consists of 4290 pieces, of which the majority are flint (4144), with some quartz (138), quartzite (3) and a coarse grained stone (5). The predominance of flint is not surprising. The quartz and quartzite are both available on the beaches, but their use seems unnecessary. It is possible that use was made of these materials at other locations in a possible annual "round" of activities.

Technology

The technology is typically that associated with a narrow blade microlithic mesolithic assemblage. The debitage is summarised in fig 13.2.

Flint			
Flakes:	<1cm:	Inner	:2667
		Secondary	: 131
		Primary	: 10
		Total	:2808
	>1cm:	Inner Regular	: 460
		Inner Irregular	: 185
		Secondary Regular	: 144
		Secondary Irregular	: 100
		Primary	: 46
		Total	: 935
	Total Flakes	:3743	
Chunks		: 122	
Blades		: 256	
Cores		: 22	
Pebbles		: 1	
Total		:4144	

Fig 13.2

Some of the blades and chunks are less than 1 cm, giving a total of 2898 pieces of flint <1cm. This represents 69.9% of the flint. This very high proportion of small pieces concentrated into this small area suggests that little horizontal disturbance has occurred, and that the material is basically in situ. (This, of course, is suggested by the discrete nature of the lithic scatter.) This also makes it clear that flint knapping was an

important activity on the site. Where possible all lithics over 1cm in dimension were recorded two-dimensionally. The distribution of the lithics may reveal knapping spots.

The cores are summarised in fig 13.3. Most of the knapping was done on prepared platform cores, with some of the preparation being very extensive. A few flakes have been found where the preparation has almost isolated the platform. The heavy preparation on some of the cores is of the type that has sometimes been assumed to be secondary retouch for use of the cores as scrapers. This is not normally accepted now to be the case, and the evidence of many flakes bearing extensive preparation removals on their dorsal faces further argues against their retouch as *scrapers*. (The cores may still have been used.)

Cores	
Platform	: 14
Amorphous	: 2
Bipolar	: 6
Blade	: 4
Flake	: 13
Mixed	: 5

Fig 13.3

Fig 13.3 also shows the numbers of blade, flake, or mixed cores. These figures are based on the last removals to come off cores, and therefore only refer to the final stage of the core's use. Of the platform cores, 10 have only 1 platform, while only 2 have no cortex remaining. This is a similar pattern to Newton (Bridgend, Islay, Clark nd), except for the much higher proportion of bipolar cores at Gleann Mor.

The bipolar technique (Callahan 1987, Hayden 1980, Flenniken 1980) used at Gleann Mor is very similar to the technique used on the Jura Mesolithic sites (Mercer 1981) especially for working the quartz. It is also a technique commonly found on "Obanian" sites. It is tempting to regard this as evidence suggesting that the knappers who used this technique in flint on Islay were at least part of a community that regularly used a bipolar knapping strategy to deal with the more

intractable quartz, although the bipolar technique is useful in reducing any small pebble material.

Typology:

The tool types found at Gleann Mor are typical narrow blade microliths and associated scrapers, miscellaneous retouched pieces, and edge damaged pieces. Absolute counts are given (fig 13.4) for comparison with the functional analysis, but obviously the more recent fieldwork has outdated this information.

Retouched Pieces		
No Retouch	: 4171	
Edge Damage	: 31	
Retouched	: 88	
Microliths	: 38	(Includes 2 quartz)
Scrapers	: 21	(Includes 1 quartz)
Other Retouched:	29	

Fig 13.4

The edge damaged pieces include pieces with possible light abrupt retouch, pieces that may have been used, and pieces that almost certainly are the result of accidental processes. The other retouched pieces include a variety of pieces not easily classified.

The complete microliths are dominated by scalene triangles (fig 13.5). Many more microliths have since been excavated, so no detailed analysis is as yet practicable.

Microliths	
Scalene Triangles:	13
Crescent	: 6
Point	: 2
Broken	: 11
Amorphous	: 1
Unclassified	: 5

Fig 13.5

Functional Analysis

Sample:

A sample of 173 pieces has been examined so far. This consists of the retouched pieces, edge-damaged pieces, blades and cores (fig 13.6). A small proportion of the available unretouched flakes were also selected for comparison. It must be stressed that this is only a small sample of the unmodified element of the material.

Type	Sample	Used	%
Blades Unretouched	10	4	40
Blades Edge Damaged	11	3	27
Blades Retouched	37	9	24
Flakes Unretouched	22	6	27
Flakes Edge Damaged	19	14	74
Flakes Retouched	49	18	37
Chunks Unretouched	2	0	0
Chunks Edge Damaged	1	1	100
Chunks Retouched	1	0	0
Cores Unretouched	21	3	14
Total	173	58	34

Fig 13.6

Analysis:

Stage 1:

Eleven pieces had to be removed from the sample. Ten could not be analysed because of excessive weathering, burning and patination and one because of inexplicable traces. There is an overall use rate of 33%, with a very low number of "opportunistically used" pieces (3%) (Fig 13.7). There is a rather high incidence of NUW.

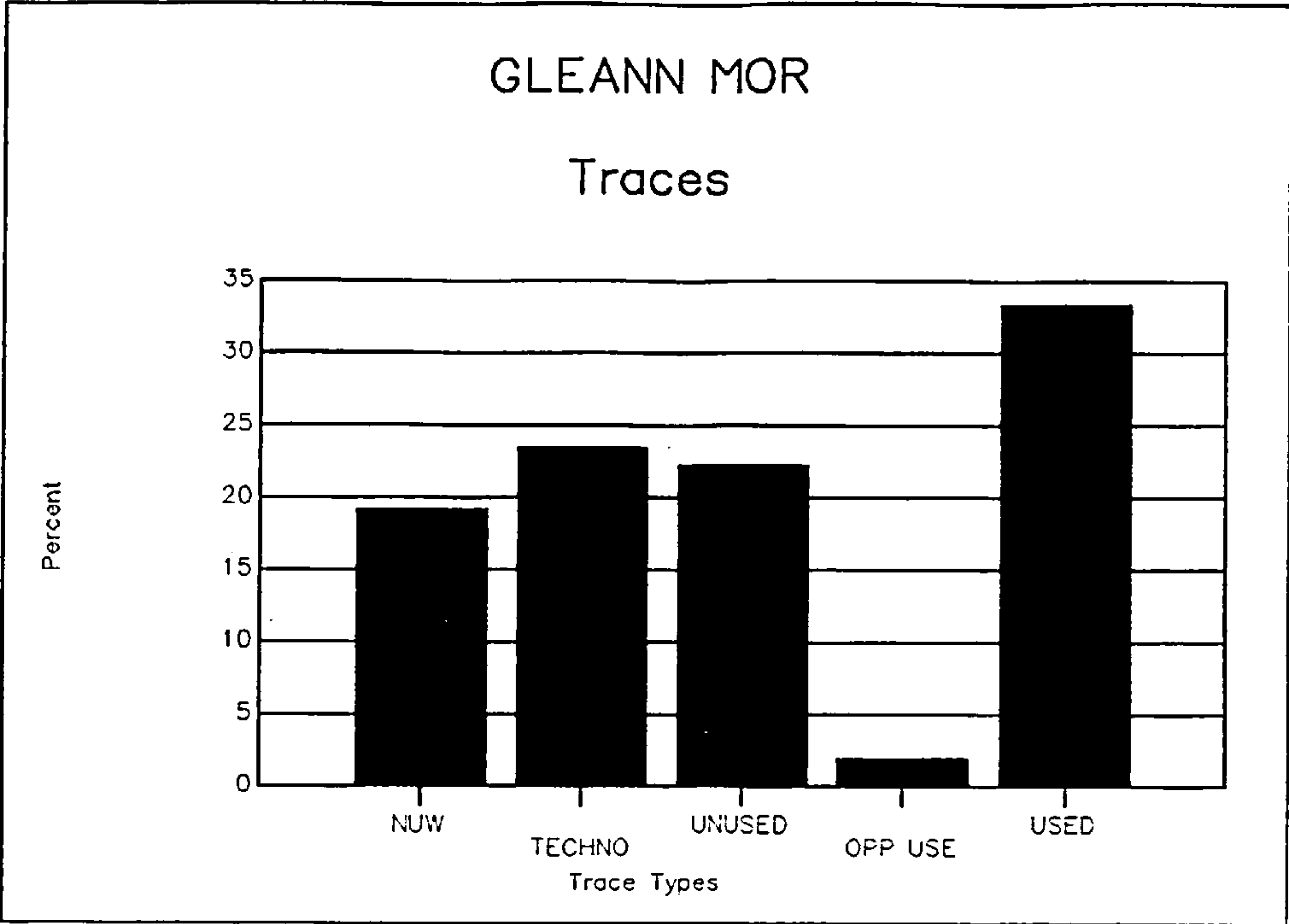


Fig 13.7

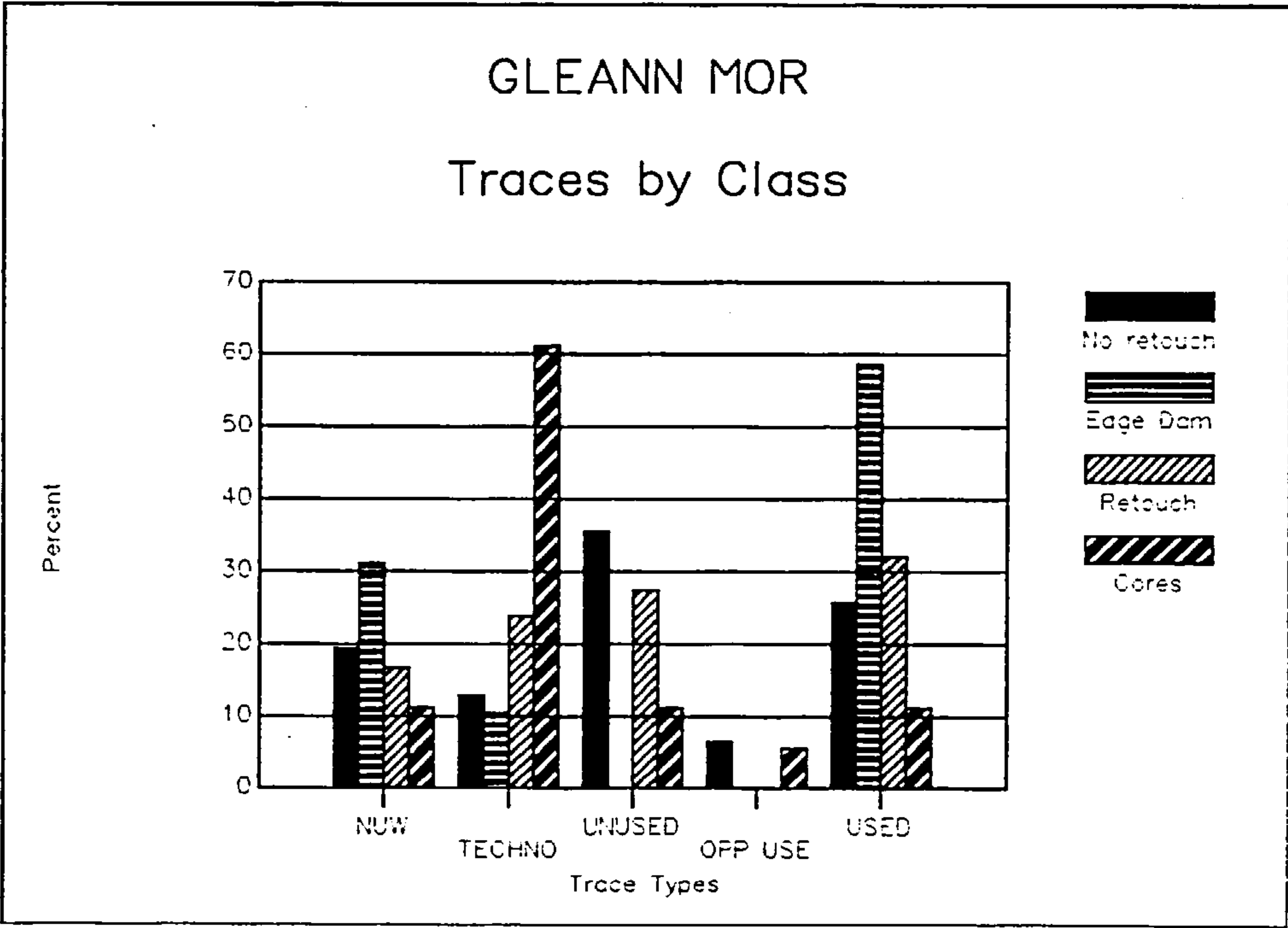


Fig 13.8

Stage 2:

The examination of each of the different categories shows an interesting variation (fig 13.8). The cores examined not surprisingly show a great proportion of technological traces. There are some use traces (11%) and opportunistic use traces (6%). Unretouched pieces have 26% used with 7% opportunistic use. Both these categories have expected low use rates, and incorporate all the opportunistic pieces. The high value of 58% used pieces on the edge damaged pieces is far greater than the nearest value of 32% for the retouched pieces. This suggests two things, first that edge damage on this sample is a relatively good indicator of use, and second, that unretouched pieces represent an important component of the tool kit at this site.

Fig 13.6 shows the percentage scores for each of the basic classes of the sample, and it can be seen that while edge damage is a good indication of use with flakes (74%), it is poor with blades (27%). This indicates a greater fragility amongst the regular blade component than amongst the flakes, with blades being more easily damaged by accidental causes.

An examination of the respective motions of use produces a very variable array, with an unfortunately high (12%) number of pieces where direction of use was unclear (fig 13.9). While, as before, there is a dominance of the two straightforward classes of longitudinal and transverse, there is a significant proportion of other motions, such as circular and complex. This last category almost certainly covers pieces which have had more than one use, but the uses cannot be clearly separated.

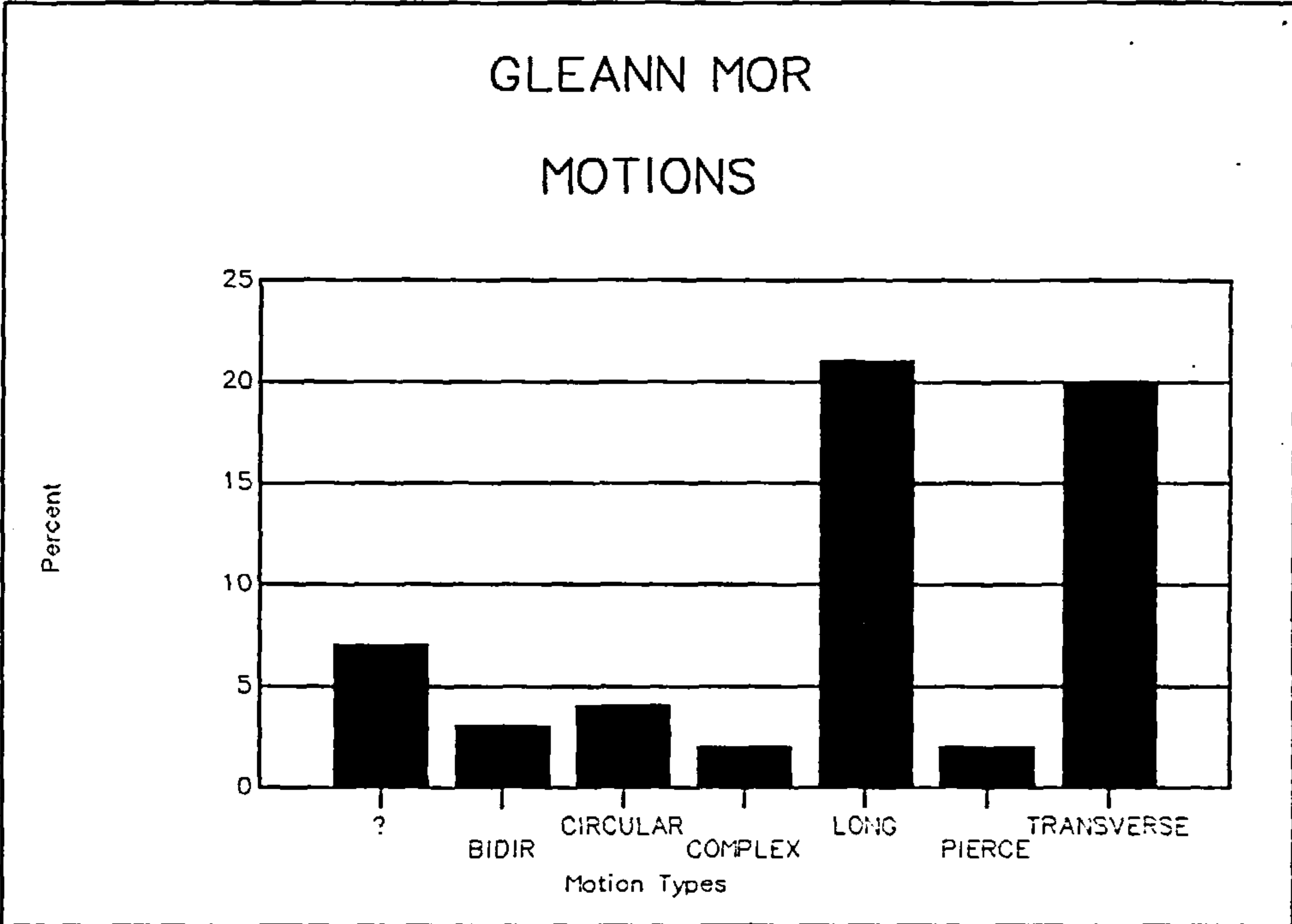


Fig 13.9

Stage 3:

The circular motions noted above are almost certainly the result of boring various materials. The pieces are listed

CIRCULAR MOTIONS			
N	Hard	Function	Blank
112	SOFT	BORE	Blade, Inner regular, edge damaged
239	MED S	BORE	Blade, Inner regular, microlith
825	MED H	BORE	Blade, Secondary regular
902	HARD	BORE	Flake, Inner regular

Fig 13.10

in fig 13.10. Each piece appears to have been used on a material of a different hardness. There seems to be no pattern either to precise function, or selection of tool.

Microliths present a more complicated picture than at either Smittons or Starr (Fig 13.11). There is evidence for both projectile and non-projectile use. The non-

Microliths			
N	Type	Motion	Interpretation
185	Truncation	Long	Bore
239	Unclassified	Circular	
409	Point	?	
1003	Scalene	Long	Projectile
1335	Unclassified	?	
1865	Crescent	?	
1886	Crescent	?	
1891	Scalene	Complex	

Fig 13.11

projectile use is in this case as a borer (fig 13.12). Unfortunately at present the microliths include a large number of those pieces that have proved difficult to classify beyond the most simple level.

The sample is as yet too small to allow analysis to provide meaningful results at this level of interpretation.

Conclusions:

Although the sample consisted predominantly of retouched or edge damaged pieces, the overall use rate is only 34%. The macroscopic observation of edge damage includes a higher proportion of recognisably utilised pieces than among undamaged pieces. There is a high correlation between edge-damaged flakes and utilisation. The opposite is true of blades, although the sample is very small. Unretouched pieces (including edge damaged pieces) were used, proportionally, more frequently than retouched pieces.

These very simple observations, based upon a very low level of interpretation of wear-traces on the pieces, provide some useful general information about the site. The basic cataloguing of the material has already indicated that the site was used extensively for knapping (principally the number of tiny, <1cm, flakes present). This was

however not the only activity going on, as mixed in with this knapping was a significant amount of tool use, markedly of the unretouched pieces (no retouch and edge damaged).

This information has some significant economic implications. If retouched pieces were being produced at the site, and not for immediate use, there is a degree of planned production involved. Pieces must have been intended to be used either later, or elsewhere. Some selection process must have been taking place as to which pieces were for use, and which were not. There is here a suggestion that the retouched pieces form part of a 'curated' tool kit.

With regard to the economic interpretation of Mesolithic sites this suggests that the basic typological analysis may be misleading if used as direct evidence for the site economy. Obviously the typological data has cultural implications, but these cannot be assessed in isolation. The functional analysis is necessary to provide some more data for economic analysis, although it cannot be used in isolation from the typological information

A functional study such as this cannot exist in isolation. It is only meaningful when applied in conjunction with a wider analysis. The Southern Hebrides project is designed to look at regional variation and a technique such as this must be applied to a number of sites. To be able to compare assemblages from different sites it is necessary to understand something of the functional element. This report must be seen as preliminary, as the current sample represents a minute fraction of the total now excavated and has only examined material from one site.

14: Functional Analysis and the Mesolithic in Scotland

This study of the functional dimension of late Mesolithic lithics has attempted to demonstrate how such functional work can be utilised, in combination with other forms of lithic evidence, to produce a more meaningful account of what the archaeological record represents. At present the sample of sites is so small that generalising is difficult, but a number of points do emerge.

One of the most obvious conclusions is that the assemblages are very different from site to site. In a sense this is not surprising. The sites have different locations, types of catchment area and access to materials. The sites are, however, not only different in terms of material and typology, but also in the way that the materials are exploited.

Microliths:

Microliths are conventionally assumed to be arrow tips or barbs. Rozoy has argued that the common basis for the Mesolithic as a distinct phase is hunting with bows. He argues that the important aspect of microliths is that they are "a pointed armature of low weight" (Rozoy 1989: 18).

This assumption has underlain many studies. Economic studies have all been based upon the equation that microliths = hunting, and that upland sites dominated by microliths represent hunting camps (Jacobi 1978, Mellars 1976). Myers has gone further and suggested that the introduction of small narrow blade microliths represents a major shift in hunting strategies (Myers 1987).

Social studies have also been based on this presumed function. Jacobi (1979) and Gendel (1984) have both used microliths as good indicators of style and therefore as useful social markers. They assume that microliths belong to only one functional use-group and that variation is therefore unlikely to be the result of functional differentiation.

There is some direct evidence for the use of microliths as projectile elements. Clark notes the microliths embedded in the Vig aurochs, and the find, at White Hill, of 35 microliths in a line, as if once hafted as barbs on a disintegrated shaft (Clark 1936). Rozoy illustrates a number of European hafted microliths (Rozoy 1989, cf Dumont 1988) and bows have survived too (cf Burov 1981).

The alternative possibility, that microliths do not simply represent hunting, has rarely been presented. Clarke suggests that microliths may have been hafted as plant processing tools, but such evidence as microliths mounted as composite sickles is rarely considered (Clarke 1976). Clark also points out that slotted bone points that have still held flint inserts have all contained *unretouched* flakes (Clark 1936).

The evidence from Starr and Smittons is important. While at Smittons all the positive evidence is for projectile use, at both the Starr sites the evidence is for several kinds of non-projectile use. Unfortunately, the number of pieces that have clear traces is too small to allow any detailed analysis of microlith typology with function. It is possible that the dichotomy between Starr and Smittons is an over-simplification resulting from this small sample size. This possibility is supported by the more complex pattern beginning to emerge from the analysis of the material from Gleann Mor.

Dumont has examined 31 microliths from Star Carr, and found no functional traces. He examined a large sample of 157 microliths from Mount Sandel, and only a small proportion had functional traces. Of these, 14 had possible projectile use traces, 5 various hafting traces, and 3 had non-projectile use traces. The projectile traces are admitted to be poor. He states that the traces on the triangles were insufficient for functional interpretation, but not "inconsistent with the usual assumption" of armature use, and that the rods were "assigned 'functions' based on the correspondence of the available traces (including the impact fractures) to the presumed [original emphasis] use of these tools as projectile tips or barbs" (Dumont 1988: 250). This interpretation, although based on poor evidence, is not supported by any experimental work with either microliths or archery. Dumont uses the HP method of

analysis based on polish "types" that recent work has called into question (Newcomer *et al* 1986, 1988 and see above). The evidence he found for non-projectile use appears to be more substantial.

If Dumont's general conclusions are accepted, it would appear that the majority of microliths are unused, with small numbers used either as armatures *or* for various other tasks. As projectile traces are not reliably produced in use, the evidence might suggest that only a minimum number of projectile uses have been observed.

The one other functional analysis of a microlithic assemblage in Scotland is the material from 13-24 Castle Street, Inverness (Bradley 1985). Unfortunately the study of these pieces was seriously hampered by cortication of the material. Three microliths had traces that Bradley tentatively suggested might be associated with archery. One piece has a polish that suggested contact with wood, interpreted as possibly the result of loose hafting as an armature; one piece has a longitudinal spall removed from the distal tip, "like those produced by Bergman in his archery experiments"; and one piece has linear polish features (Bradley 1985: B13). Bradley admits to a lack of experience with archery and the resulting traces, and the implication is that the interpretation of these traces is at least partly guided by the assumed function of the microliths.

Another brief study of microliths was made during the course of this project, when all the microliths from the site of Starr 2 (excavated by the late Tom Affleck, near Starr 1) were examined. Only the microliths were examined for functional evidence at this site. The assemblage from Starr 2 is small (153 flint pieces and 264 chert pieces), but generally similar to Starr 1,

Starr 2 Microliths		
	Flint	Chert
Scalene Triangles:	5	
Backed pieces:	2	3
Fragments:	1	1

Fig: 14.1

apart from a much higher blade component (Affleck, Edwards and Finlayson nd). Only 12 microliths were found (Fig 14.1). Of these microliths only 4 have traces that resemble those resulting from use.

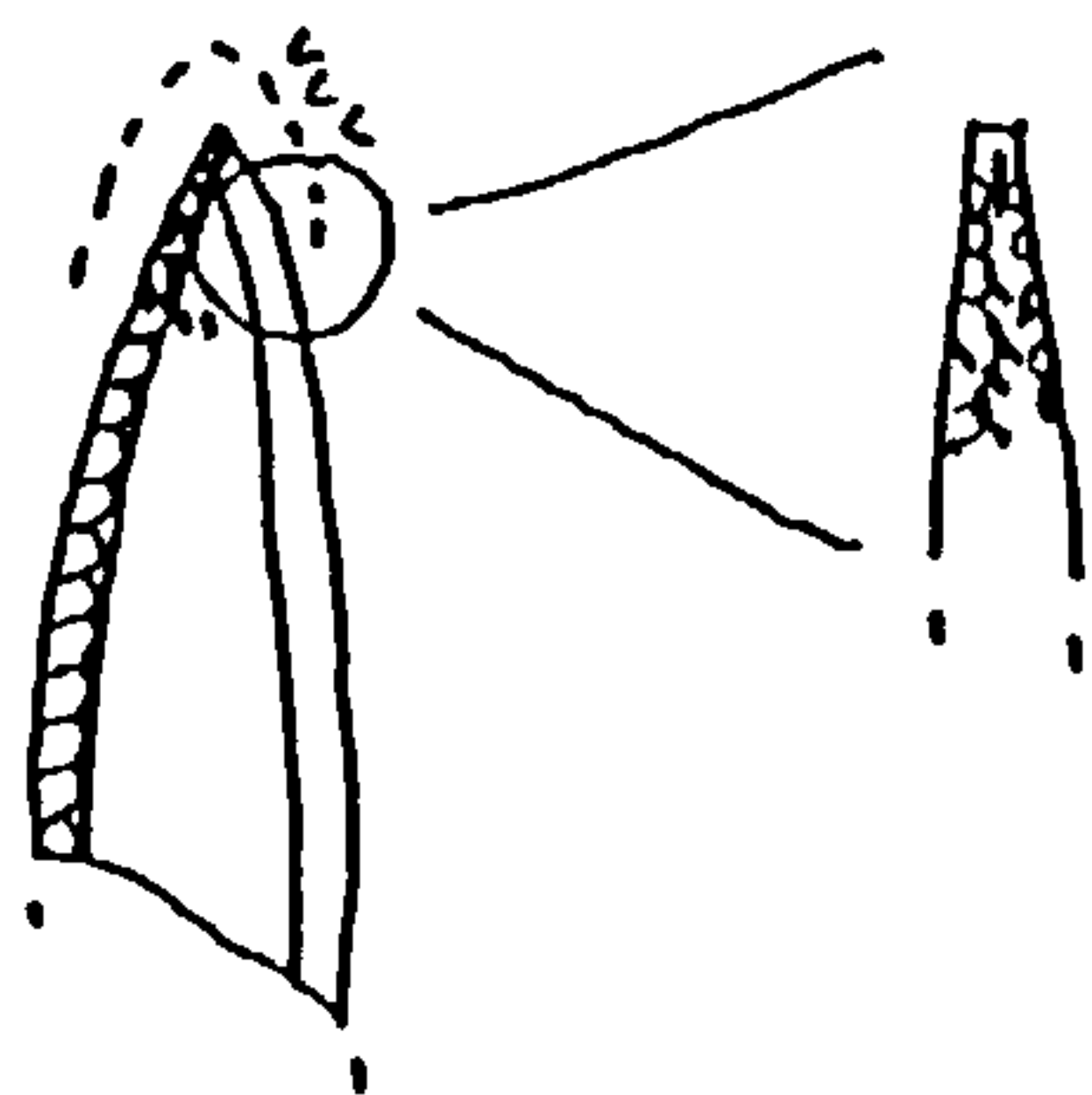
One piece (S2 45, backed piece, snapped) has definite wear traces on the distal tip, but these traces are clearly not the result of projectile use, but appear to be the result of a circular/twisting motion piercing material that was soft enough not to cause significant damage to the tip (Fig 14.2).

A second piece (S2 55, scalene triangle) also has clear wear traces. Despite the small size of the piece (15x5x2), these traces suggest that the piece was hafted (traces at B running perpendicular to the tool main axis), and was used as a 'knife', cutting at an angle. The feather terminations, and limited development of the edge damage, and the development and invasive nature of the polish suggest working a fairly soft material.

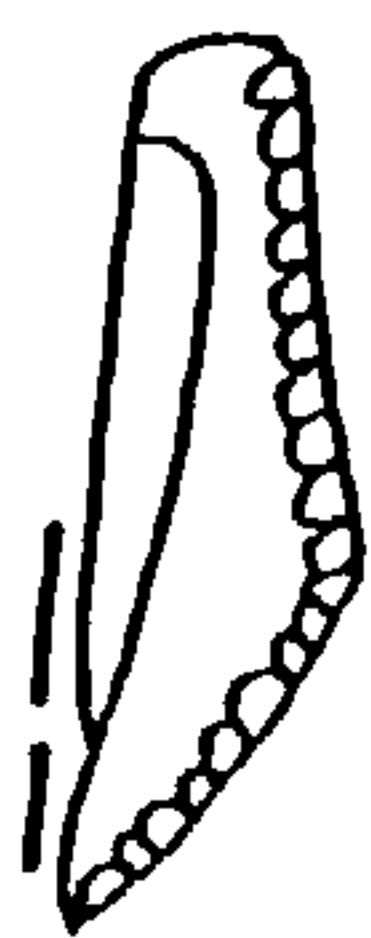
The remaining two pieces with possible wear traces (S2 52 scalene triangle, S2 53 backed piece) are more problematic. They both have traces that may be the result of use, but are confused by NUW traces. Detailed interpretation of these traces is impossible, but it appears unlikely that they were used as projectile components.

This evidence supports the interpretation of the Starr 1 microliths: microliths were not being used for projectiles. While a certain degree of error is inevitable in such studies, this basic interpretation does not rely on any details of high powered analysis, but can be made by simply examining the location of traces, and their distribution on tools. Only a small number of projectile experiments were made during this study, but the general appearance of projectile utilisation traces have now been described in a number of studies, principally by Fischer *et al* (Fischer *et al* 1984, Fischer 1989), with work also reported by Barton and Bergman (1982). The experiments conducted in the present study (see chapter 7 and appendix A) extended the above information to include narrow blade microliths. Polish features similar to those reported by Fischer *et al* (1987) were found, although much of the macro damage that occurred was undiagnostic, and consisted of the point

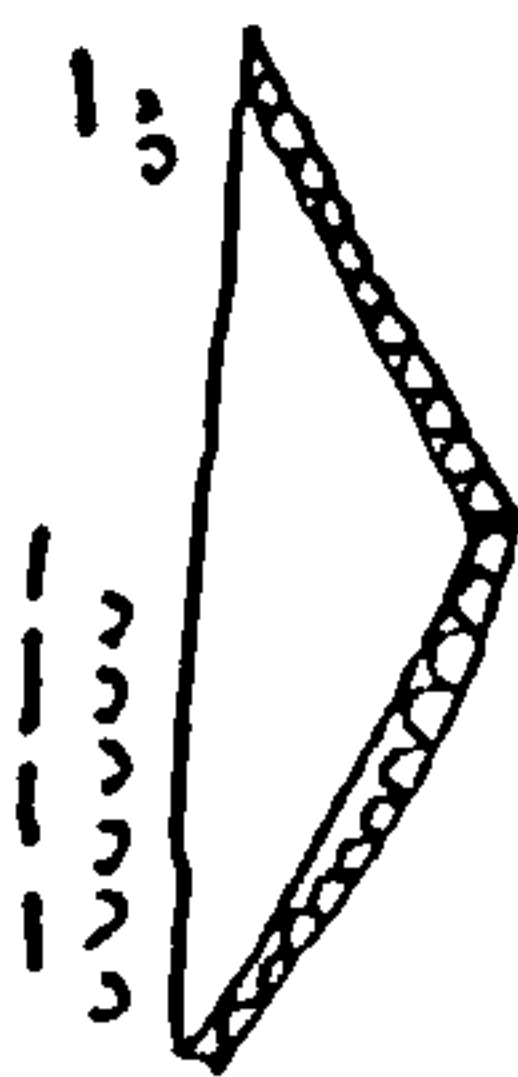
Fig 14.2 Traces on microliths from Starr 2



S2045



S2055



S2052



S2053

snapping accross the middle. One important observation was that, with the small microliths used, very little protruded from the shaft and hafting media (Plate). Such small barbs could only have been designed to increase bleeding and not to hold the weapon in the target. Even accepting that the barbs may have been intended to fall out in the target, the small size of many microliths found means that most of the piece has to be embedded into the haft or hafting media.

Wear traces that fit the parameters established by the various experimental projects were found at Smittons, suggesting that such traces could be successfully located. The absence of such traces at Starr 1 and 2, and the presence of traces that fit well with other forms of utilisation, indeed of several different forms of utilisation, suggests that the interpretation of non-projectile use is well founded.

Function and Typology:

The relationship between typology and function is questioned by the high incidence of use of non-retouched pieces. While this decreases the value of typological data for economic analysis, it potentially increases the value of typology for stylistic and social analysis. More detailed work on the functional variability of the different microlith types is required. Variation in the function of microliths may mean that their use as a "type-group" of artefacts with similar function and therefore high stylistic meaning (Gendel 1984: 47) may be inappropriate. Gendel also assumes that microliths are projectile elements, and therefore, following Wiessner (1983: 260), have high visibility and so suitability for stylistic messaging. The evidence from the sample studied here suggests that microliths do not have the high visibility of projectile points. Their variable use does not suggest a high value in ritual or ceremonial contexts (Gendel 1984: 43). They appear more as frequently utilised components of a number of different tools. This implies a more mundane role, with low visibility.



1

MICROLITHS HAFTED

Raw Material and Technology:

The variations in availability of different tool materials, and the different techniques that may be required to work them are essential factors in the analysis of any lithic assemblage in Northern Britain. The relationships between the exploitation of these materials and their function is fundamental to any analysis.

Edmonds has argued that the immediate importance of the lithic tool-kit to a society varies depending upon the type of risks that the society faces. In a settled farming society the risks are generally long-term (drought, crop disease, etc). The tool-kit has limited immediate impact on these risks, and the Neolithic farmer can afford a certain *ad hoc* approach to tool manufacture and use. In a mobile hunter-gatherer society where risks are generally short-term (success in hunting) the efficiency of the tool-kit is vital to survival (Edmonds 1987). Assuming a traditional model of Mesolithic economy, the tool-kits studied here should reflect this importance.

Edmonds' model suggests that there are a number of features that should be expected:

- 1) Reliance on high quality stone.
- 2) Efficient use of stone.
- 3) Production of efficient tools.
- 4) Production of standardised, easily adaptable tools.
- 5) Production of small/light tools.

These features take account of both the risk element and the high mobility expected of such a culture.

In a highly mobile society it is necessary to control the size and weight of the tool kit. The use of a high quality stone assists this process. Blades and microliths both represent pieces of low weight. The standardised nature of both blade blanks and microlith types means that they are suitable for standardised composite tools. Such composite tools *may* be specialised, if they all use the same standard, replaceable, lithic components. This allows maximum situational variability (Binford 1979). This production of standard, non-task-specific lithic elements increases the portability of the tool kit. It allows rapid repair of tools

where short-term risk factors are important. The potential use life of tools is another important factor, both through repair and recycling and through the quality of the original tool.

The tool procurement strategy is also affected by the type of risk faced by a society. A mobile society has the option of embedding their procurement strategy into their movement cycle, whether that is seasonal or not. This can be more efficient. While lithic sources may be scattered, they are static, and visits can be scheduled to fit the activity cycle. Other activities may of course impose constraints upon the procurement strategy (Edmonds 1987).

At Smittons and Starr the relationship between the use of flint and chert is interesting. Both sites have a number of features in common:

- 1) Chert, the locally available material, is more common than flint.
- 2) The use of chert apparently increases through time.
- 3) Flint is represented by a higher proportion of retouched pieces than for chert.
- 4) Lower proportions of flint cores suggest that much of the flint may have been imported 'ready-knapped'. The more intensive working of flint cores than chert cores, and the higher incidence of waste in chert reduction make this point hard to quantify.

The overall patterns of débitage for the flint and chert are different. The flint has a much higher incidence of primary and secondary flakes. This is probably the result of the nature of the different raw materials and not of deliberately different reduction techniques. It does however produce two sub-assemblages with markedly different characteristics. It is possible that if the two materials were not obviously part of the same assemblages, but were found on different sites, they might be presumed to be the result of two different groups' activities. The similarity of the retouched elements could be interpreted as the result of convergent evolution, or the deliberate copying of the final product by a different technology (Bonnichsen 1977).

This has implications for the study of lithic assemblages in western Scotland. Flenniken (1980) notes the possibility of a strategy that uses the locally available materials during a seasonal round. At each location a different material may be available, and a different reduction strategy appropriate. In these circumstances it may be hard to perceive cultural unity. If the different localities also involve a change in site function (a likely occurrence), different tool-kits may be required, making the identification of cultural groups even more difficult. It is possible, given the apparent chronological overlap between "Obanian" and narrow blade industries (Bonsall and Smith 1989), that a similar phenomenon may be present in the West of Scotland.

At both Smittons and Starr the importing of flint to the site, the more intensive use of flint cores, and the higher incidence of retouch on the flint all suggest that it may have had a higher "value" than the local chert. The most obvious explanation for this use of flint is the model proposed by Edmonds.

The use made of the flint appears to match the predictions made above. Flint is a "better" quality stone than the chert. At both sites it has a higher proportion of blades and retouched tools, especially microliths. Flint cores are more heavily reduced than chert cores.

The evidence does not all fit the model. At Smittons the use rate of flint is definitely below what would be expected and many pieces, far from having a long use-life, have only been used lightly. The model, however, presumes that one reason for using the flint is the possibility of producing tools with a long potential use-life.

The presence of chert is an additional complication. The probable pre-selecting and coarse knapping (as at Starr 3) does fit the model, as it represents the selection of a high quality stone. However this fact negates part of the proposed evidence for the use of flint as a "better" quality material. If the quantities of locally available chert permit this "wasteful" technique to be employed, then the knapping advantages of the flint become reduced.

The increasing use of chert over time may indicate an increasing understanding of local raw materials, following initial colonisation of

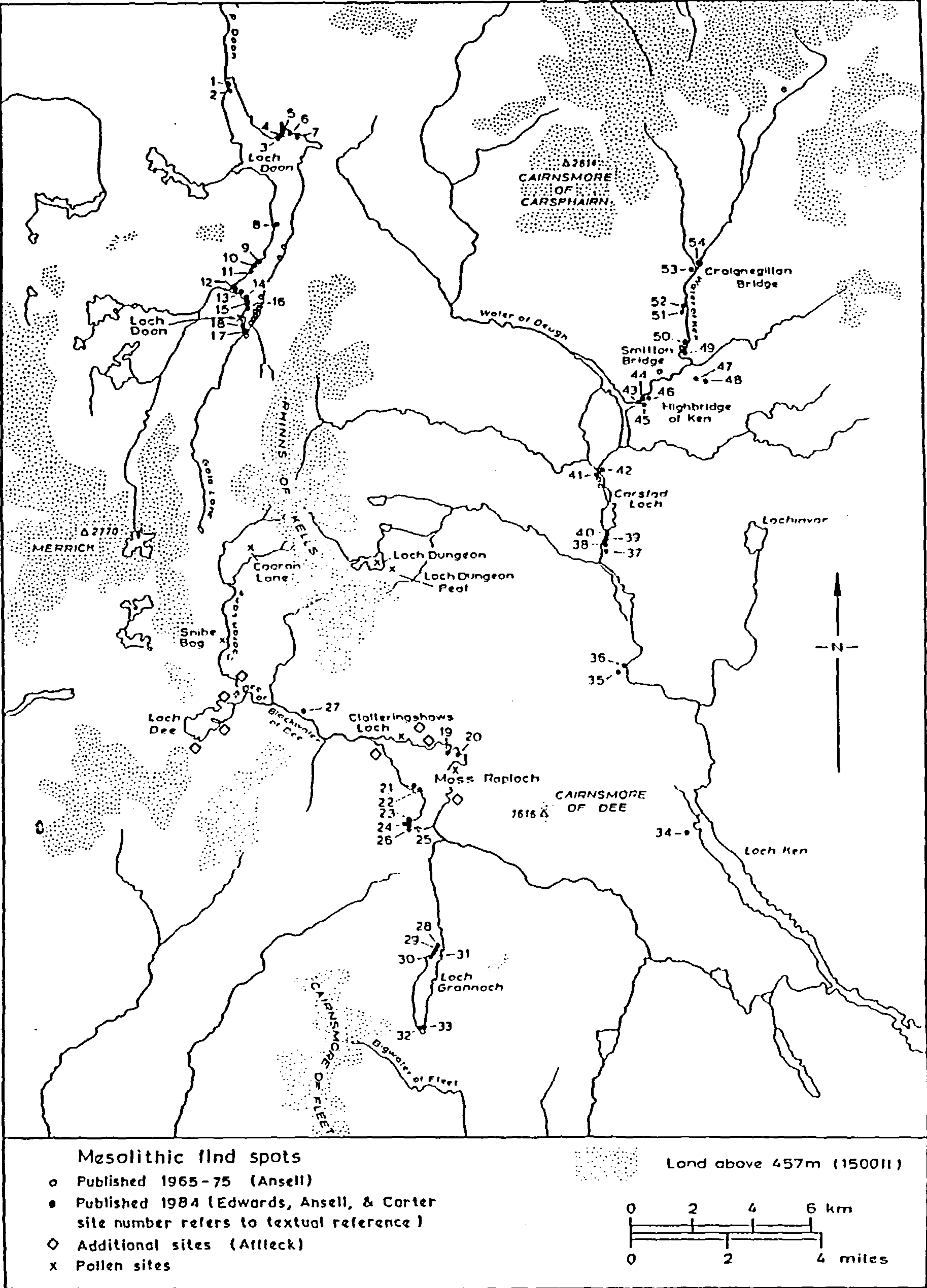
the area from the coast (Affleck). As the properties of the chert became known, its apparent disadvantages could be overcome, enabling the light-weight standard tool-kit to be made. A similar phenomenon has been noted in the Pennines, where it has been suggested that increased use of local materials was the result of decreasing annual cycles and more intimate local knowledge (Jacobi 1987). If Affleck's hypothesis that chert was used increasingly through time is accepted, the excavated material from Starr 1 may represent the earliest of these occupations.

It is unlikely that the variation in the employment of raw materials can be explained by any one cause. One point to note is that, despite the overall similarities between Smittons and Starr, there are differences in detail. Smittons appears to be the result of two occupations, while Starr is the result of a number of small occupations. Higher use rates from Starr may reflect the activities of small task camps, while Smittons was a more generalised site. If Starr represents the activities of small task groups, then the importance of a light-weight tool-kit may have been more important than at Smittons.

Another strand of evidence is the difference in type of microlith function. Although the samples are too small to permit detailed analysis, they are not identical. Scalene triangles are apparently more important at Starr (both sites) than at Smittons. Functionally the two sets differ. The longitudinal (and bidirectional) motions discovered at Starr may explain the use of flint. Flint does generally produce the better long sharp edge, and tends to keep that edge longer. Such stability would not be so important at Smittons, where the microliths are primarily being used as armatures.

Despite the proximity of the two locations and the relative ease of travel along stream routes through the area (Edwards *et al* 1983; cf Fig 14.3) it is possible that they belong to different "cycles". Smittons could belong to a Solway coast - upland round and Starr to an Ayrshire coast - upland round. Such a situation could explain differences in material use, and apparent material values. The occupants of Smittons may have had a good flint source embedded in their annual round, and may have simply carried some with them without treating it as a special material. The users of the Loch Doon sites may have had to procure the flint specially.

Fig 14.3 Mesolithic find spots and water systems, after Edwards (1989)



There are differences in the raw materials used along the Solway Firth. Around Luce Bay flint is used almost exclusively, while a variety of materials are used in assemblages from the mouth of the River Nith (Cormack 1970). On the Firth of Clyde, Mesolithic assemblages at Girvan and Ballantrae are predominantly beach flint, but include Arran pitchstone, quartz, chert and chalcedony (Morrison 1980). These variations may reflect not only local availability of materials, but also the availability of materials elsewhere in a group's round.

The position of the Gleann Mor material is different. Survey work on the beaches around the Rhinns peninsula show that there is a relatively plentiful supply of flint. If the source of this material is Loch Indaal (Finlayson and Sinclair *nd*), then this supply may be restricted to this peninsula, and the East shore of the loch. It was noted during the functional study that the use-rate of retouched pieces was low, while the use-rate of unmodified pieces was high. The pattern of use of blades is more similar to the retouched material than to the unretouched flakes. If Mesolithic groups exploited the flint on Islay as a valuable resource, then this would be the expected pattern. At this site, in the source area, a high incidence of knapping would be expected. There would also be a high incidence of retouched pieces produced for removal from the area, to less flint-rich areas within the region. Portable blades would also be saved for 'export'.

To be able to test this tentative suggestion, it is necessary to expand the study from one site to encompass a wider area. In addition to examining the material from sites, it is also necessary to examine the availability of raw materials. By conducting this study within the framework of the Southern Hebrides Mesolithic Project (Mithen 1988), a regional perspective is gained. It can be hypothesised that if the flint source is in Loch Indaal, then flint should be relatively rare on the beaches on the East coast of Islay. (A preliminary investigation found *no* flint.) A different use of the material should occur in Mesolithic assemblages. The Jura material (Mercer 1980) incorporates a high proportion of the local quartz, and this may reflect the drop off in flint availability.

Upland/Inland sites:

The conception of upland/inland sites as representing hunting camps, either as part of an annual cycle, or as used by task groups, has to be reconsidered if one of its main props, microliths = hunting, can be questioned. Although the significance of hunting should not be underestimated, the potential of areas such as Loch Doon and the River Ken for resources other than red deer should be remembered. Fish are one obvious food resource, and the importance of non-food resources, for example the exploitation of chert, should also be considered.

Jacobi has suggested that there should be lowland sites that go with the upland sites, and believes that these could be located by having "identical microlithic tool kits" (Jacobi 1979: 302). Again the assumption is that microliths are stylistically important. However, if lowland sites represent functionally different occupations, there is no reason to assume that a microlithic component should be identical. Relationships between lowland/coastal sites and upland/inland sites may not be simple. As Bonsall has demonstrated, some coastal sites have potential for year round occupation, and may have had the best resources available to them at the same time that upland hunting is assumed to be in progress (Bonsall 1981). The lack of chert from the Luce Bay sites may reflect a lack of seasonal mobility amongst Mesolithic groups in that area.

Conclusion:

With the apparent contemporaneity (or at a least substantial overlap) of the narrow blade mesolithic and the "Obanian" (Bonsall and Smith 1989) an integrated approach to the lithic assemblages needs to be made, to assess whether the two apparently distinct tool kits mainly represent two functionally separate entities. The use of locally available materials in Scotland (flint, chert, pitchstone, quartz, jasper, bloodstone, silicified sandstone) solves problems of flint availability, but means that differences between assemblages can be exaggerated. If a low-energy system of tool manufacture (Flenniken 1980) is being utilised, then it

may prove very hard to demonstrate links between different aspects and regions of the Mesolithic occupation.

The above discussion illustrates the difficulties in interpreting the evidence, and how important it is to study more than one dimension of the data. By studying the relationship between raw material, technology, typology and function against the environmental evidence, it may prove possible to solve this problem. Only once this type of study has begun will it be possible to begin to explore the presence of social territories in the Mesolithic. The analysis given here can only be seen as a preliminary investigation into the complexities of Mesolithic society.

15: General Applications

One (deliberate) element of the technique developed here is that its "low level" approach means that it is less sensitive to different tool materials. This means it can be applied to a wide variety of assemblages. It is still necessary to conduct experimental work in the local raw materials where possible, and at least as importantly, to make replica tools of the kind in the assemblage to be analysed.

The case studies included here are from Kissonerga Mosphilia (Cyprus) and Jebel Naja (Jordan). Two different problems were posed by the excavators, both of which were successfully addressed by the technique.

The background lithic analysis was not performed by the author in these cases. This means that the approach is rather different, as instead of having been involved in the overall lithic analysis strategy, the functional analysis was imposed upon a pre-existing scheme.

16: Kissonerga-Mosphilia:

Site Background:

This case study is concerned with material from the Chalcolithic site of Kissonerga Mosphilia, South West Cyprus (Peltenburg 1987). The site is very different from the Scottish Mesolithic sites. There are large buildings (>8.5m diameter) with plaster floors, pottery (including large storage vessels), burials; all the paraphernalia of a permanent settlement. There is no doubt that the bulk of the subsistence was based on agriculture. The site belongs to a period when metal had been introduced to the economy. Numbers of well made ground stone tools are present. The chipped stone tools occupy a peculiar position, in that both from a typological and a technological viewpoint their quality seems to have deteriorated from the Aceramic Neolithic period. Their poor quality is in marked contrast to the finely made ground stone tools, (mostly axes and adzes, some over 20cm in length, and some with traces of use) (Elliot 1987) and pottery present.

Lithic Problems: It was the apparent poor quality that first caused this material to be taken up as a case study. Little information was being derived from the chipped stone tool assemblage by typological analysis. What limited characterisation could be achieved was based upon a very haphazard collection of retouched tools with little real homogeneity, described as consisting of "a limited repertoire of rather poorly formed tools" (Betts 1987: 10). The questions that were asked at the outset were therefore:

- 1) Could a functional approach provide more information than a traditional typological one?
- 2) Did the typology (poorly defined as it was) reflect functional divisions?

3) Was the chipped stone tool assemblage unimportant functionally and did this explain the apparent lack of interest in tool manufacture?

4) There appeared to be surprisingly few "sickle blades"; were there more, but only marginally used sickles, not recognisable to the naked eye?

This initial study was conducted in the manner of a feasibility study. (More work is planned, but has been temporarily held up by logistical problems.) As a consequence of this, and the very broad type of questions asked, a small sample of 93 pieces was selected incorporating a wide variety of types. For this initial work no account was taken of spatial or chronological variation. Work started on this study during the development of the functional technique, and contributed significantly to its development. Experimental work was conducted using the locally available cherts, which appear to be the same material as used in the chalcolithic.

Sampling:

The sample was not selected by strict random collection, but by a rapid grab from available excavated pieces. Details of the lithic assemblage analysed are based upon work up to the 1986 season.

⁹ The assemblage consists of 4291 pieces, with 540 pieces classified as "tools". Retouched pieces are classified into scrapers, borers, denticulates, notches, burins, sickle elements, knives, miscellaneous (and multiple), retouched flakes, blades and chips (See fig 16.1). A category of "used pieces" had been developed, based on edge damage, but preliminary functional analysis suggested that this category was the result of multiple causes, and it was consequently dropped from the typological analysis (Betts 1987: 12). It was kept for the purposes of this study, to test the possibility of such visual recognition of use.

Tool classes			
Type	N	%	N for sample
Scraper	144	26.67	9
Borer	9	1.67	1
Denticulate	48	8.89	6
Notch	88	16.3	5
Burin	34	6.3	8
Sickle element	18	3.33	10
Knife	12	2.22	0
Hammerstone	5	0.93	0
Miscellaneous	14	2.59	2
Retouched Piece	168	31.11	27
	<hr/>	<hr/>	<hr/>
Total	540	100.01	68
"Used"			11
Blank			14
			<hr/>
Total			93
Fig 16.1 (Information from Betts 1987 14)			

Functional Analysis:

The sample was studied following the method described in Part 2. The detailed catalogue of pieces and traces is given in appendix C4.

Stage 1:

- ⁹ The initial breakdown of the wear traces (Fig 16.2) shows the proportions of traces. A proportion of those traces (13.95%) is ascribed to Non-Use-Wear Traces. This figure is understandable given the nature of the site, where post-depositional damage from continued occupation would be likely. This high incidence of NUW makes it hard to ascribe a small number of the pieces to any category; this includes most of the pieces with "opportunistic use".

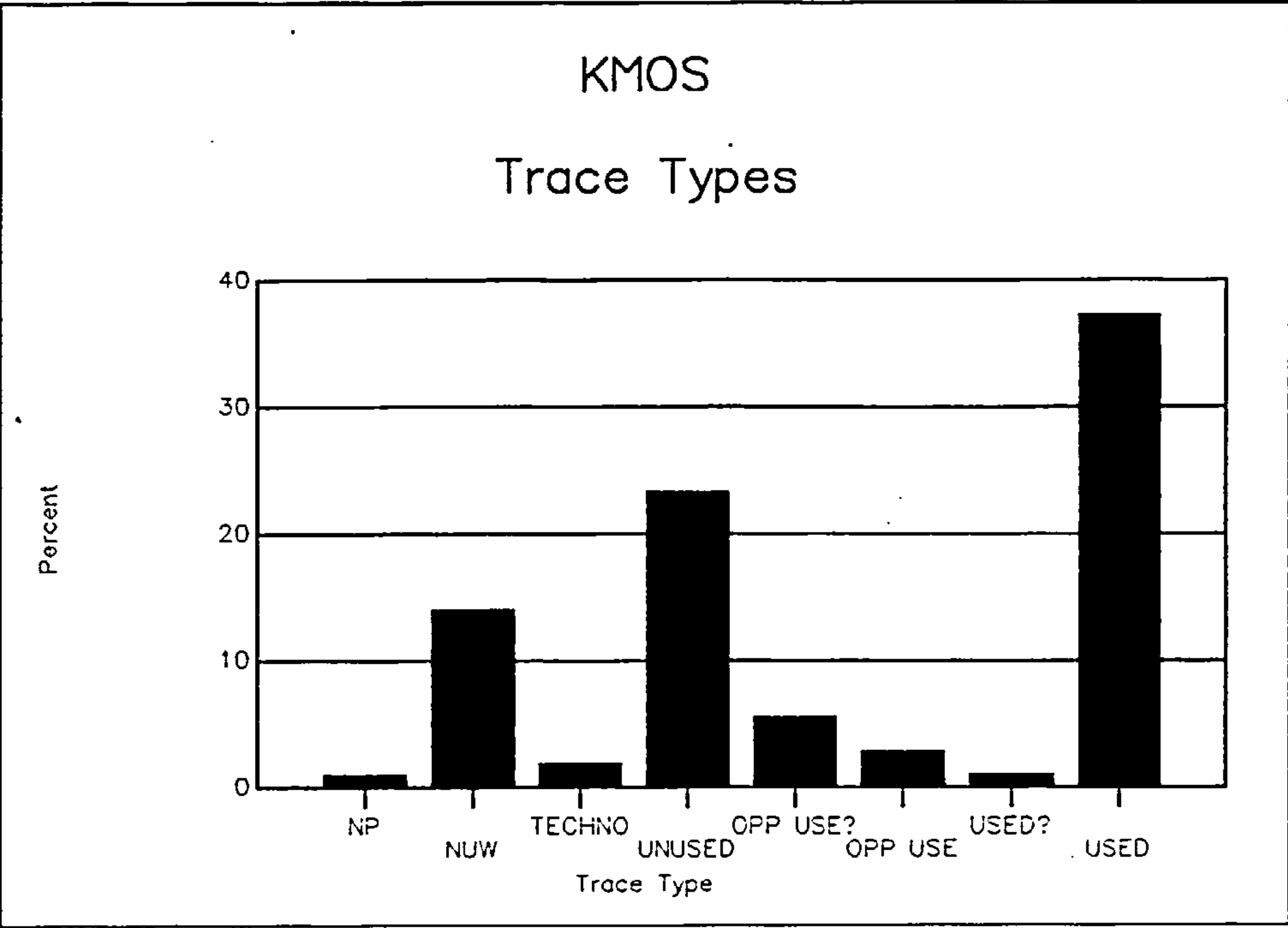


Fig 16.2

Fig 16.3 shows the proportions of definitely used pieces per type. It can be seen from this that the "used" category included many unused pieces, however it *does* represent a significantly higher proportion of used pieces than the blanks (the unretouched pieces),

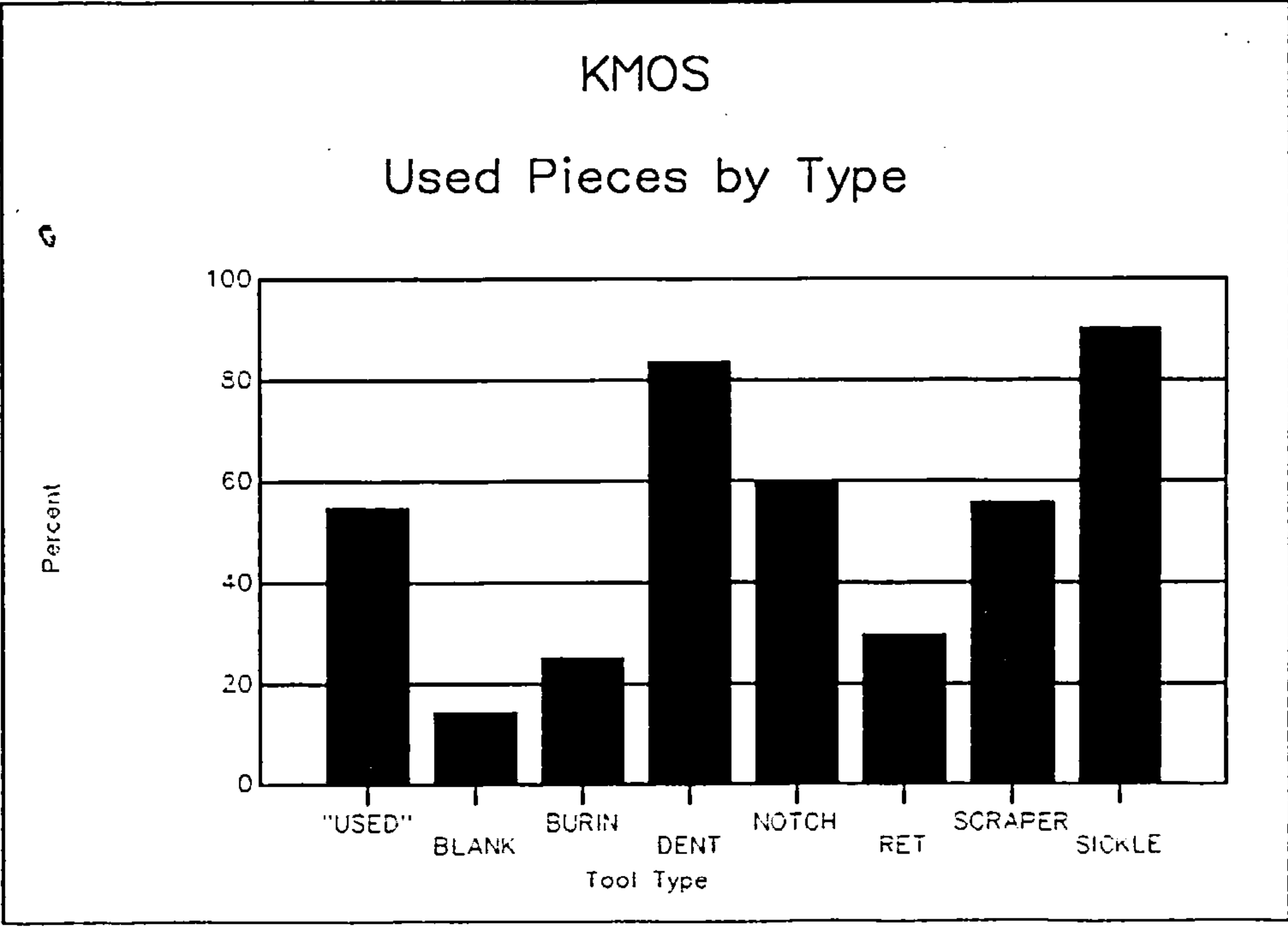


Fig 16.3

examined. With the exception of sickle elements (with one piece, surprisingly *not* in fact used) denticulates have the highest use proportion. The borer and multiple tool do not have traces of use.

Stage 2:

Analysis of the pieces with clear traces of use shows that except for the burins and sickle elements, no category is represented by a single class of motion (Fig 16.4). Both these types have other variations in use discussed below. While the number of pieces used (and examined) in each category is small (Fig 16.5), this general observation of variation in type of use is significant. Scrapers are dominated by transverse motions, but this motion is not unique. Denticulates are

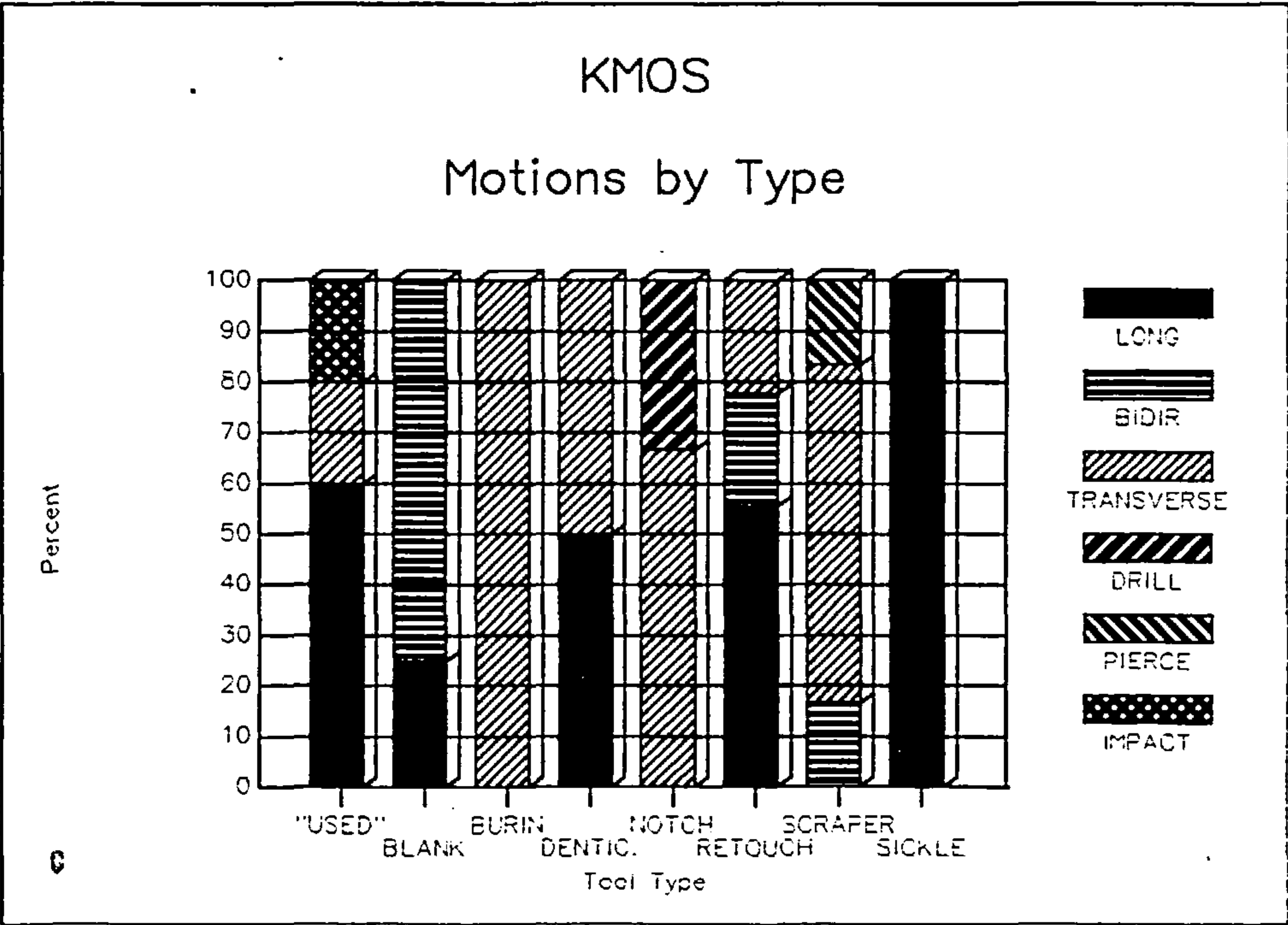


Fig 16.4

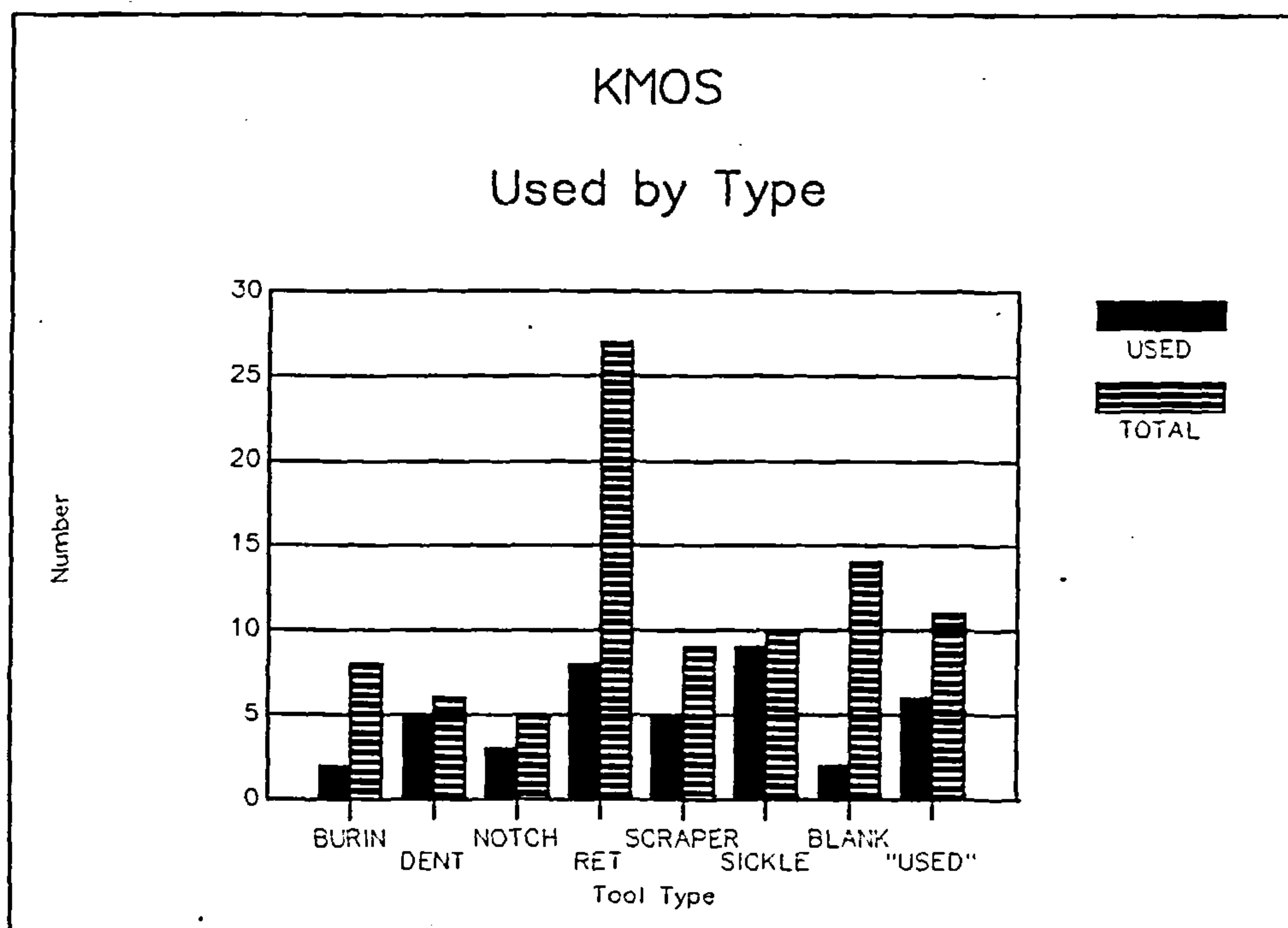


Fig 16.5

divided equally between transverse and longitudinal motions. Unretouched used pieces are in fact all longitudinally used, the variation in their useage being with pieces where bi-directional long motions have been observed. It must be noted that bi-directional movement can not always be discerned, and that some of the pieces classified simply as long movement may be bi-directional.

This poor relationship between tool type and general class of motion can be clearly seen in Fig 16.6, which emphasises the variability in tool use patterns between transverse motions and longitudinal (including bidirectional) motions.

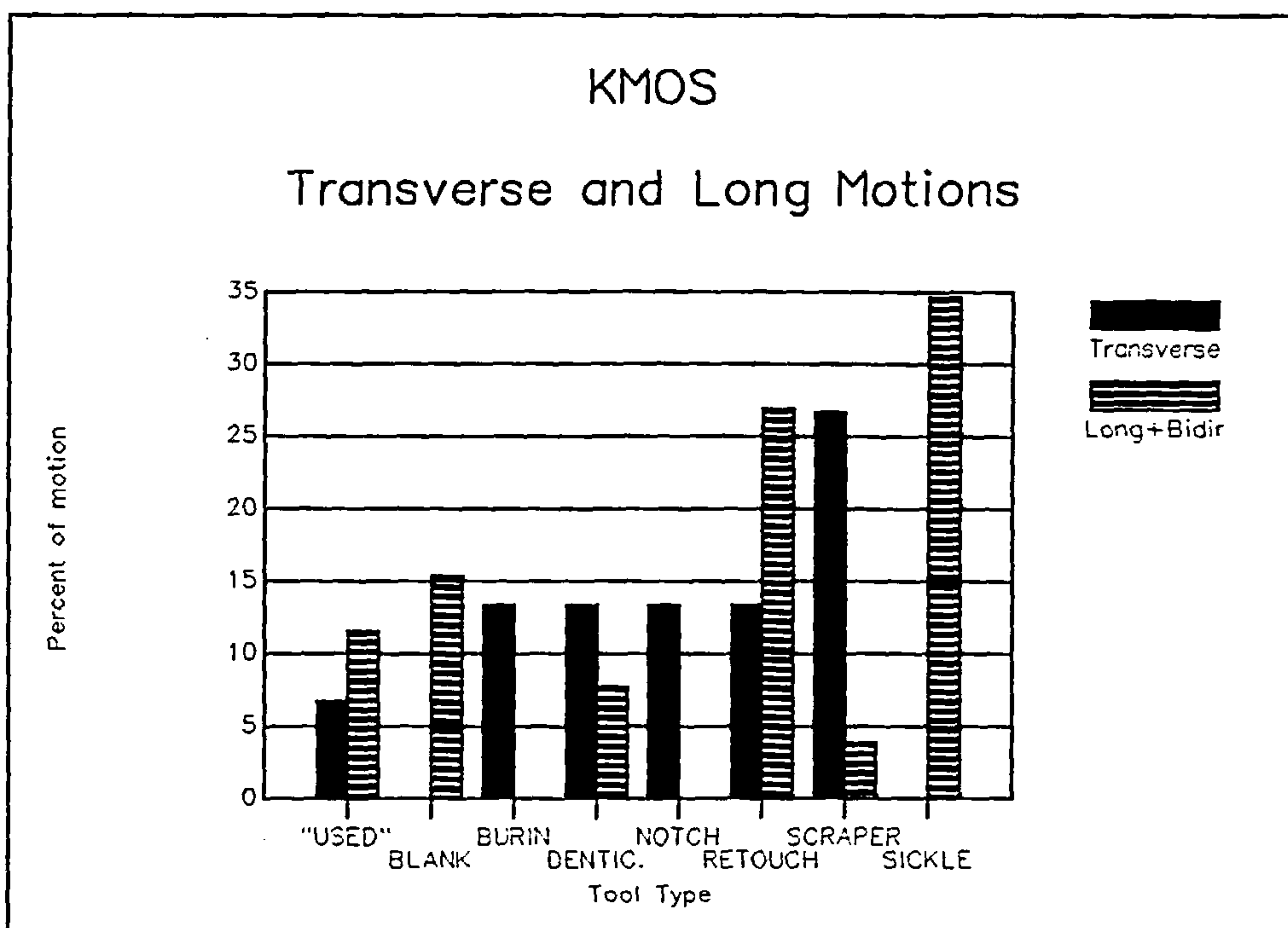


Fig 16.6

Further details concerning individual pieces can be noted here. One denticulate (KMOS 20) was in fact almost certainly not formed by retouch, but by extreme edge damage. A notch (KMOS 111) was also possibly formed during use, or at least significantly modified by that use. This is of interest, in that both these classes of tool include a wide range of "notching", much of it irregular. The evidence suggests that the observed typological classes are not always the result of deliberate manufacture design. This represents a form of observed class not being matched by function and being the result of different means of production.

A second form is where pieces are definitely retouched, and therefore deliberately made, but are utilised differently, suggesting either that types were not necessarily associated with function, or that our perception of morphological types in an assemblage of this nature is poor. The clearest example of this phenomenon is the use of a scraper in a bi-directional long manner (KMOS 194). In this case the evidence from the location of wear traces on the lateral margin and the absence of traces from the retouched end, suggest that the "end scraper" retouch was used as a finger rest. Other examples of this exist, one denticulate edge is unused, while the opposing burin-like facet is used (KMOS 42),

the burin facet on KMOS 450 (a burin) is unused, but the opposed edge is. It can be noted that despite the apparent homogeneity of burin use, only two pieces classified as burins were used (Fig 5), and only one of them using the burin facet. These two pieces and the denticulate-used-as-a-burin indicate that the apparent homogeneity of the burins' use is in fact illusory, if it is accepted that a homogeneous burin class should, if used, have their burin facets used. It is, of course, possible that some burins represent accidental impact fractures. The possible function of burins as cores is set out below in the study of Jebel Naja burins.

The sickle pieces are also a problem. Far from proving to be a minority of sickles observed, the use-wear traces observed on the sickle elements do not form a single homogeneous group. Instead two distinct types of wear pattern appear, with a similar development of edge damage, but differing degrees of polish development. The nature of these traces suggests that these are two distinct sets of traces, and not part of one wear pattern development sequence.

Stage 3:

The detailed interpretation of the use of such varied sample is difficult. Notes of interpretations for individual pieces can be found in the appendix. Of interest is the notch (KMOS 111) with traces of drilling matching very closely with pieces used experimentally to drill pot sherds. These experimental pieces described above also produced traces on the drilled potsherds very similar to those found on archaeological drilled potsherds. (The function of these potsherds remains a matter for speculation.)

It is suggested that the closest pattern of traces achieved experimentally to some of the sickle element traces is from wood working, although more extreme. Such a greater development of traces might be the result of a substantially longer use of the tool. It must be noted that no detailed sickle experimental work was conducted in this study, and that information on sickle wear traces is all derived from other reports (principally the work of Unger-Hamilton and Anderson-Gerfaud). It is possible that the variation in wear traces represents the reaping of two

very different "crops". What is clear is that there are two distinct patterns of traces present.

Nearly all the traces suggest the working of medium to very hard materials, and the range of materials represented probably includes wood, bone and possibly antler. (Picrolite working is another possibility, but no pieces examined have as yet had traces analogous to those from experimental picrolite working.) Wood-working appears to dominate the likely materials identified, even including one apparent chopping tool (KMOS 354), despite the presence of the ground stone tools. There is evidence for the working of medium soft materials, but no clear evidence for the working of soft materials. The degree of NUW present may help to account for this. Certainly because of the nature and frequency of the NUW it was felt that a very cautious approach had to be followed with pieces with minor possible traces.

Conclusion:

Four basic questions were initially posed for this case study. The results of the work provide interesting, if not entirely straightforward answers.

4) There were no observed cases of marginally used sickle elements; in fact rather than increasing the overall number of sickle elements, it appears that two functions are represented by these pieces, in effect reducing the number of sickles, although they may represent two reaping activities or seasons (Unger-Hamilton 1983). The low numbers of sickle elements cannot at present be explained by a failure to notice them, and an alternative explanation, such as the abandonment of worn-out elements in the fields, very short term use of sickles (unlikely if hafted), or alternative harvesting methods, must be sought.

3) The chipped stone tools were significantly used; an overall figure of 37.2% of the pieces examined had clear traces of use. In addition many of these pieces had traces suggesting use on hard materials, particularly wood. This raises two interesting points. The first is that the heavy ground stone tools did not completely replace the chipped stone for heavy work (indeed one piece was probably used to chop wood). The

second is that much of this aspect of the tool use is in longitudinal motions, some clearly bi-directional. Some of the so called sickle elements may also represent wood/long motion tools. If this is the case, far from being unimportant functionally, the chipped stone may in part represent a vital part of a wood-working tool kit, the saws and knives (or "fine" wood working element). It is possible that the lack of morpho/typological clarity is a result of the importance of this type of work, where retouch is unimportant, and the most functionally useful aspect is a sharp unretouched edge.

2) The typology does not appear to reflect function well. Most types appear to have been used in different manners, and different parts of the tools have been utilised. In addition the "manufacture" of some types includes deliberate retouch on some pieces, and use damage on others.

1) The functional analysis has certainly provided different information to the typological work. The work so far has produced rather negative results with regard to the typology, but at present the sample is too small to allow a more constructive analysis of morpho/technological attributes. It can however be suggested that in an assemblage that is not clearly typologically analysed, it may well prove to be more productive to conduct an in depth functional study in conjunction with a broader analysis of the entire lithic assemblage. It is possible that it might prove possible to analyse the potential non-functional significance of the morphology, and that stylistic details might emerge.

Further work is planned to examine a larger sample with more detailed contextual information. More detailed work on the debitage has begun.

17: Jebel Naja:

Site Description:

Jebel Naja (7340+/-100bp: OxA-375) is a classic burin site, that is to say that burins massively dominate the assemblage (Betts 1988). These sites are typical of the desert fringes in Jordan. At Jebel Naja 81% of the excavated tools are burins, predominantly truncation burins. There are other retouched pieces, scrapers, borers, bifacial knives and drill bits on burin spalls. At Jebel Naja there is good evidence for the manufacture of beads, in the form of beads in various stages of manufacture, and the burin *spalls* with scarring suggesting use as drill bits. These beads are the only other artifacts apart from the stone tools. It has been suggested that these sites represent a change from the previous hunting economy, and they are no longer located on the tops of hills, but on sheltered slopes, much where present day pastoralists camp.

The problem posed by the excavator was very straightforward: Were the burins used? This question was refined to

- 1) Were the burins used and if so, was this
 - a) sporadic use
 - b) a uniform particular use
- 2) if not 1b), how did this use compare with general use patterns.

Only a very small sample was analysed (40 pieces). This included 20 pieces of non-burin extraction, originally collected to test for background noise in answering 1), and also used to examine 2). Although the sample is very small, and it is therefore impossible to make general conclusions, it was sufficient to answer the original question. As the sample is so small, it is necessary to deal with pieces on a more one-to-one basis than normal, but as only a limited question is asked of the data, this practice was seen as acceptable.

There are a great number of possible uses for burins, Both the burin bit and the burin facet edge are usable, as well as the rest of the tool, The burin bit may also have been used for hafting, and there is also the possibility, in this case, that the truncation was used as a scraper edge (Moss 1983c: 146).

Preliminary Work:

In addition to the archaeological material examined, a number of replicas were made to examine possible technological features that might confuse the analysis, These were made from English chalk flint and from a red chert from Cyprus that is similar to the Jordanian chert, Three features were noted that were also found on some of the archaeological material,

- 1) An intermittent linear polish along the edge of the burin scar, smooth and invasive into the microtopography of the chert.
- 2) A restricted patchy polish at the hammer impact point, smooth and flat, obscuring the microtopography of the chert.
- 3) Clustered layered scars at the hammer impact point occurring in the event of the collapse of the platform.

It appears from the pieces examined that as well as the technological background noise, post-depositional or accidental damage in the form of random edge scarring is common on the archaeological pieces . A sample of other material from the site was examined to confirm this hypothesis,

Further analysis problems were caused by the presence of patination on some pieces and on one piece a gloss marked with scratches that is outside the author's personal experience, but looks like the feature described as desert/wind gloss, These problems and the small size of sample so far examined mean that a cautious approach had to be taken in

the analysis that follows, At present none of the replica burins have been used, In the light of the results of the analysis it seems unnecessary to conduct specific use experiments with them.

Analysis:

Detailed descriptions of the used burins are presented in appendix C5.

The Burins

Of the 16 burins examined so far only 3 show definite traces of use, with 10 showing no traces of use, The unused pieces have, in some cases, an assortment of unpatterned, poorly developed traces that are most likely the result of post-depositional processes, (For example, most edge damage present is on acute, thin edges and consists of snap removals, typical of trampling; most polish present consists of random bright spots, or poorly developed, scattered polish, only formed on the high points of the microtopography, typical of soil movement effects.)

Of the three used pieces, one (JN015) has very restricted, but well developed, traces of use at the distal end of a burin scar, where a sharp, thick, notch has been formed by the removal, Here there is a cluster of deep, mostly feather terminating scars on the dorsal face, Associated with these, but distributed on both edge aspects is a well developed, smooth flat polish with sharp edges, It appears that something narrow and relatively soft has been pulled firmly against this notch, A possible explanation is the cutting of some fibre or cord, or the removal of material from such an object.

The second of the used pieces (JN016) has similar, although not so pronounced, features in a similar location, More noticeable on this piece is a set of traces on the unmodified edge (straight in plan and thin to medium in angle), These consist of bifacial scarring, (deeper on the ventral aspect), with mostly feather terminations, The angled position of the scars suggests a bidirectional force, as if the piece was pulled

backwards and forwards through some material, Associated with this scarring, again on both aspects, although less developed on the ventral surface, is a polished area, This consists of a general spread of a smooth patchy polish, invasive into the microtopography of the chert, gradually fading out at the edges, Numerous irregular pits are present, This runs along the edge and continues away from the immediate edge, On the more elevated parts of the topography the polish is better developed, the pits are less common and the microtopography is obscured by the polish which becomes domed in appearance.

This combination of features suggests a sawing motion (bidirectionality from the indications of the scarring), penetrating the worked material to produce the polishing away from the edge, The material was relatively soft and yielding, producing a polish invasive into the microtopography and mostly feather terminating scars, The domed appearance of the better developed polish also suggests a medium soft material, possibly soft wood, The straight, thin edge supports this suggested use, while the relatively minor damage to the thin edge angle reinforces the interpretation of a soft contact material.

The third used piece (JN001) has a complicated set of traces, Most of these are concentrated on the side opposite the burin removals, although in this case not an unmodified side as there are a number of flat retouch removals on the dorsal surface, The edge angle however remains thick, Associated with these removals are a concentration of traces, These include scarring, clustered and layered, mostly feather terminating, but the smallest scars along the edge being mostly step terminated, The ventral aspect only has the smaller, step terminating flakes, There is a general spread of a very patchy, rough polish, and along the extreme edge a line of smooth polish, slightly bevelled around the edge, Running at about 45° are common narrow, shallow, short striations, An assortment of poorly patterned features exists on the other side of the tool.

From the appearance of the polish along the extreme edge only, bevelled and terminating sharply, and from the rough, non-invasive spread of polish away from the edge, it appears that the contact material was relatively hard, This is reinforced by the presence of step terminations

in the scarring, although the larger mostly feather terminating scars are more difficult to explain (they can occur on relatively hard materials when the face is kept under pressure), The presence of the flat retouch makes interpretation of the scarring more difficult, The indication of the striations and location of the traces suggests a short cutting motion, Traces on the opposite side are possibly the result of pressing the tool through the hard material involved, The pattern of scarring on the thick edge angle further suggests a hard contact material with considerable pressure applied.

Of the remaining three pieces, one (JN014) is the piece with the gloss/scratch marks that obscure any other traces, one (JN007) has some peculiar traces that suggest a circular motion with the thick butt end of the tool, and the third (JN018) has some traces upon the burin bit, These traces are the only ones in the entire sample that remotely suggest use of the tool as a burin, However, in the light of the experimental series, the traces of scarring fit within the variation found on unused, collapsed platforms, The associated polish is poorly developed, and could have been caused by a number of agencies, including the hammer blow and subsequent flaking, As this is the only piece in the sample to have traces that might be from use in this fashion, the most reasonable explanation must be that these traces are the result of manufacture, or possibly brief expedient use.

Debitage

A sample of twenty unretouched pieces (8 blades, 12 flakes) was examined, primarily to provide the background information on post-depositional, non-use features on the burins, During the course of this examination it was found that a number of these pieces had been used,

Nine of the pieces had clearly not been used, although they had varying degrees of random edge damage, and in some cases a general all-over glossing of the surface, The edge damage on at least one of these pieces is almost certainly recent, A tenth piece had a considerable quantity of bifacial scarring along one side, with no other associated potential use-features, This degree of scarring, with this lack of supportive evidence,

cannot be interpreted as resulting from use, A more likely interpretation is of incomplete secondary modification to the piece, A further two pieces had considerable edge damage with patches of poorly developed polish, The location and extent of these features both fit within the parameters of post depositional soil effects and are unlikely to be the result of use.

The remaining eight pieces all have some traces probably derived from use, Of these two, (JN035 and JN022), have very limited traces, restricted to the end or corner of the pieces, bifacially distributed, which suggests grooving or incising, The traces are not very pronounced and the use is likely to have been brief.

One piece (JN032) has a pattern of traces that strongly suggests a transverse motion, The straight, sharp edge used has bifacial edge damage, but with a predominance of scars initiated from the dorsal face, Restricted to this dorsal face is a well developed polish running along the extreme edge of the tool, The polished edge appears rounded, and the polish domed with numerous minute circular pits, Away from the extreme edge and around the periphery of the scars is a similar, but less distinct polish, scattered around the high points of the microtopography, This type of unifacial polish pattern associated with opposed edge scarring (mostly shallow scars with mixed terminations) suggests a medium hard material was being worked with a shaving motion,

The remaining five pieces all have traces that suggest a longitudinal motion (bifacial distribution of traces, striations parallel or sub-parallel to tool edge, pronounced direction to scar initiation, and location of polish traces on surface topography), three of which also have features that indicate a bi-directional or sawing motion (predominantly scar initiation in two directions), Of these two (JN040 and JN026) were probably heavy duty saws on hard materials, In both of these cases the utilised edges are thick, but the edge damage is well developed, The scars have mostly step terminations, and polish features are restricted to the extreme edges of the pieces, Penetration of the worked material cannot have been deep, The polishes are limited to the higher parts of the microtopography, One other piece (JN031) may have been used in a similar manner, although its edge is not as thick, and the polish traces,

although restricted to the extreme edge, are more invasive into the microtopography, These three pieces are the ones with suggested bi-directional use.

The remaining two pieces have acute edges utilised, One (JN028) appears to have two separate localities used, although with almost identical trace patterns, It is impossible to state whether these represent two separate instances, or, more likely, the adjustment of the tool during use, The bifacial scarring is always feather terminated suggesting (in conjunction with the edge angle) a soft worked material, This is further supported by the distribution and nature of the polish patterns which are spread broadly across the surface of the tool away from the edge, They are frequently invasive into the microtopography, or spread flat, obscuring the original surface texture, The collection of features taken together suggests that a soft material was cut deeply.

The remaining piece (JN024) is more problematic, The edge damage to this piece is in fact predominantly unifacial, but the polish patterns associated with it are bifacial, and are distributed in a manner more indicative of longitudinal use than transverse, Indeed the most distinct polish features are around the scar perimeters (the opposite face from the expected position if a transverse hypothesis was used), away from the edge, In experimental work conducted it was found that edge damage was more frequently misleading in its location than polish, Particularly on an acute edge this effect could happen when the longitudinal motion was conducted slightly off the perpendicular, This happens frequently as a result of the unbalanced cross section of flint tools, The actual work of the tool was probably to cut a medium hard material, as the edge damage is mostly step terminating and the polish restricted both to the edge or near the edge of the tool, and restricted to the higher parts of the microtopography.

The drill Bits:

A very small sample of burin spalls were examined during the course of this work, Of these, three were used as drill bits and two remained unused, Unlike the drill bits described by Calley and Grace (1988) there

is no smoothing to a conical tip, rather the scars become layered and crushed, The extreme tip does become roughly subcircular, The scars are varied in form, but include a number of feather terminating scars, sometimes a majority, One piece has no visible polish, possibly the result of rapid scarring, but equally probably the result of a weak patina, One piece has a smooth, scattered polish, restricted to the high points of the microtopography, The third piece has a similar polish pattern, but also has some linear polish running around the piece on one face, This consists of several narrow bands of a similar polish, the only difference being its linear arrangement,

The scarring suggests a medium hard material was drilled (presence of feather terminations with the step terminations, crushing and layering), This accords well with the materials used to manufacture beads on the site, The scar pattern suggests a dominant clockwise motion in use, Penetration depths are different in all three cases, The medium hard hypothesis is supported by the fact that the scarring has not turned into the form reported by Grace.

Conclusion:

Regardless of the precise interpretation of the used burins, it is clear that they were not regularly used as burins, Further, their form as burins appears to have been ignored when they were used, Both JN001 and JN016 have the unmodified/non-burin side of the piece used, although in the case of JN001 there is a hint that the flat edge caused by the burin removal may have been used as a suitable place to apply pressure to the back of the tool, The notch used on JN015 (and possibly on JN016), although caused by a burin removal is the result of that removal terminating abruptly, in an atypical manner, and cannot be seen as "burin use", The main purpose of the burins would therefore appear to be as cores for the spalls, This is to some extent *borne out* by the variation in form in these burins, which is too great to suggest any deliberate end product in mind, and where multiple removals frequently destroy any "burin bit" or any thick burin removal edge that could have been used as a plane edge,

Out of the very small sample of pieces so far examined, there is in fact evidence of a higher use ratio amongst the "debitage". This evidence should be treated with a great deal of caution, not only because of the sample size, but also because not only was there no attempt at randomising the selection process, but there was in fact a positive bias to larger or blade-like pieces. For similar reasons no attempt has been made to integrate the interpretations of the wear traces, which would be pointless in the absence of any more complete examination of the assemblage.

18: Conclusions

The overall purpose of this project was to develop a method that could prove useful to the wider discipline of archaeology. As such it had to be sufficiently rapid and reliable to enable reasonable samples to be examined with an acceptable level of accuracy. In addition, a proper consideration of the place of functional analysis in lithic studies and archaeology as a whole had to be made.

Despite, or perhaps because of, the low level of interpretation given in the case studies presented above, it is felt that these studies do represent useful archaeological work. They are either linked to specific archaeological problems, or attempt to deal with some of the assumptions that are commonly made in typological analysis.

Generalisations from this data have to be made with caution as the samples analysed have been small. It should however be possible to rapidly increase sampling now that the method has been developed. At the same time experimental work will continue in an effort to improve the method, and to expand the approach to more materials, technologies and tool types. While the results of Graces's (1989) HP work are encouraging, and may represent a method suitable for some types of functional work, it is believed that the method developed here has wider applications. The intractability of many of the materials examined, and the theoretical position which does not demand high precision answers, but does demand adequate sampling, all mean that a more "rough and ready" technique has distinct advantages.

The Method:

There remain a number of problems with the method. Some are the inevitable result of the approach taken, while others, it is hoped, can be rectified in the future. The problems can be divided into three main parts:

1) Level of interpretation: The precision of the interpretations given is not as high as that attempted by most other functional analysts. This is the result of three factors:

- a) The results of blind tests and the theoretical basis of the work suggest that such precision will frequently be spurious.
- b) The method is designed to examine large samples, and cannot therefore spend as much time per sample as other methods have done.
- c) The method has been used primarily on "second-rate" materials, where analysis is more difficult.

However, for extremely specific questions, such as those faced in the analysis of "sickles", more precise methods are more suitable, if their accuracy can be demonstrated. It is unlikely that the method outlined here will ever be capable of such detailed work. It is however possible that in such cases it could be useful to apply this method to samples as an initial stage of the investigation.

2) Sample size: Because of the repeated re-examination of the case study material, the samples analysed in this study are of a similar size to those analysed in conventional microwear. An additional limiting factor was the fact that they relate to different time periods, raw materials, and geographical areas, necessitating several sets of experimental work. Samples will be considerably larger now that the method has been developed. However, the samples analysed by the method developed here are unlikely to reach the scale of "low power" samples. They will still represent a considerable investment for any project. It is hoped that the case studies demonstrate how useful such information is, and how limited analysis of lithic material can be without an understanding of the functional dimension.

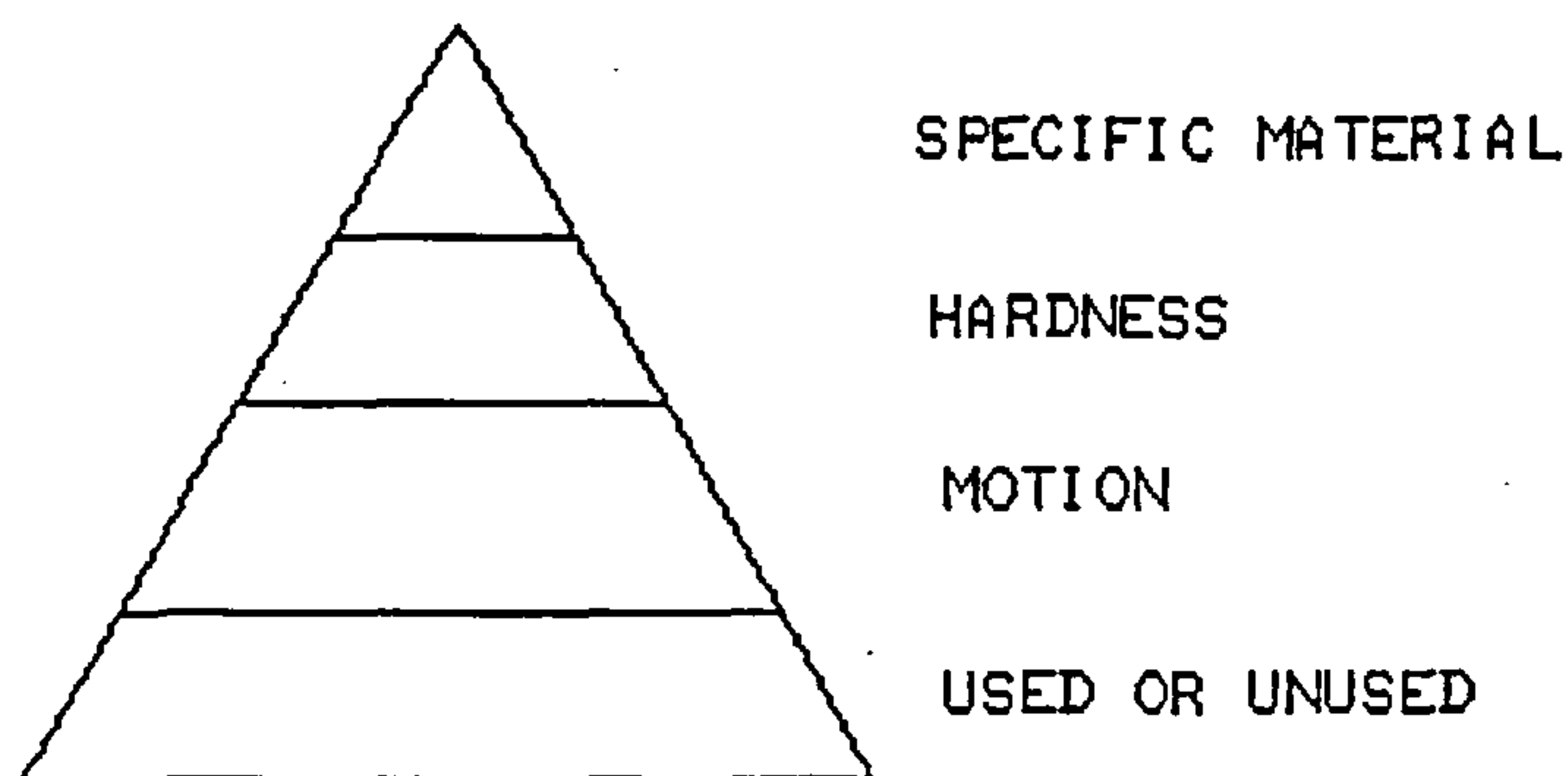
3) Basic Accuracy: It is clear from both the results of the blind test conducted here and from the inability of the analyst to interpret some traces recorded in the case studies, that even at the earliest stages in analysis there are still problems with interpretation. More experimental work will help to reduce this problem, if it is carefully targeted. In particular it is seen that more emphasis on hafting/prehension and on tool use by a wider variety of people needs to be made.

Obviously functional analysis is not a simple remedy to the problems of lithic analysis. The value of functional analysis is limited by the quality of the other available information, including context, chronology, material and environmental background. As stated, one of the initial requirements of the method was that it should be capable of providing information of use to archaeology as a whole. Part of that usefulness depends upon the questions that are asked of any individual functional analysis. Another aspect is whether the method is capable of answering those questions.

The chief requirements of such a method have to be its accuracy, its precision, and its ability to analyse a suitable sample size. Some of the problems in these areas have been mentioned above, against these can be put the benefits of the method.

Accuracy: Blind tests have shown that functional analysis, regardless of method, has serious limitations. Accuracy does not refer here to the ability of the method to achieve high powered individual interpretations of detailed tool function. It does refer to the degree of confidence that a given interpretation may be correct. The thrust of the current project is that accuracy is more important than detail. It is more useful to have some limited information that is probably correct, than some detailed information that is probably wrong. All the blind tests conducted suggest that the description of precise worked material is likely to be wrong, especially with the inevitable increased difficulties of working with prehistoric material. Unfortunately many analyses have continued to be made that provide interpretations to that level. The method developed here restricts interpretation, on an item by item basis, to only that information that can be confidently gathered from a piece. This does not prevent useful analyses from being made. By treating the material in a stage by stage manner all the different levels of information can be incorporated into the analysis. The presentation of the case study material in this stage by stage manner was done in part simply to identify the value of this approach. As there is a general reduction in the number of pieces that can be confidently analysed at each stage, such an

approach is essential, as it allows the many pieces that have some useful but limited functional features to be included (Fig 18.1).



Decreasing number of pieces with adequate evidence for each more difficult level of interpretation

Fig 18.1

Precision: Precision is related to accuracy, but is not the same thing. Precision refers to the amount of detail that can be ascribed to an individual piece. As stated above, concern for accuracy means that levels of precision are reduced. Elaborate reconstructions of an individual tool's use are unlikely to be made with much confidence in their accuracy. The method developed here cannot provide such dramatic reconstruction. It is, however, suggested in this work that precision is not as important as accuracy. In addition it is suggested that early claims for precision have created an artificial market for such detailed work because of its dramatic nature and not because of any real archaeological value. It is argued here that many of the high precision interpretations provide little useful information (apart from any considerations of accuracy). There will always be occasions where high precision is desirable, but in fact most HP analysis has concentrated on generalised questions. In these circumstances the level of precision given is redundant given the size of the sample analysed. Even where it may appear that a high precision answer *might* be required, as in the analysis of microlith or burin function, the method employed here has produced very interesting results at low precision. While the method will never be able to detect whether different combinations of microliths

might relate to specific tools designed to maximise the hunting of specific targets (Zvelebil 1986, Myers 1989), for example differences between bird and herbivore arrows, it seems unlikely that any of the currently employed functional analysis methods could provide this level of information. The confident identification of microliths as both armatures and as non-projectile tool components is possible using this method, and is of great value. The identification of a few tools as having been used for woodworking is more rarely useful.

Sample Size: Linked to both accuracy and precision is sample size. Sample size is affected by the number of pieces that have information that can be incorporated into the analysis. The method developed here enables a larger sample to be analysed due to its greater speed. Because of the stage by stage approach it also permits a higher proportion of the pieces analysed to be included, and not discarded as having insufficient evidence present. Because of the improved sampling the method is more suited to answering some of the general functional questions frequently asked, and of great importance to studies linking lithic evidence to behaviour and subsistence activities (Torrence 1989). These questions involve details of curation versus expedient tool use, relative perceived value of lithic materials, and broad classes of function.

The Case Studies:

The case studies presented here represent work in various stages. Because of this, and the various problems they have attempted to deal with, they are not directly comparable. They all use the same basic method developed in Part 2. In no case do the analyses depend upon a high level of interpretation for the identification of precise worked material.

Scottish Mesolithic:

The studies from Smittons and Starr are essentially complete. Excavations at Glean Mor continue, and more material will be examined. The overall pattern of the assemblage may well change too, altering the general interpretation. It is hoped that a much broader study of Mesolithic material may be conducted, to examine the relationships between raw material, technology, typology and function, and to allow more meaningful generalising statements to be made.

Summary of the evidence:

Smittons:

- 1) Chert dominates the assemblage with 73% to 25% flint.
- 2) Chert cores are disproportionately common, with 85% to flint 15%.
- 3) There is a higher proportion of blades amongst the flint debitage (19.5%) compared to the chert (15.5%).
- 4) A higher proportion of the flint is retouched than the chert (9% to 4.5%).
- 5) The use-rates of flint and chert are very similar (flint 39%, chert 38%) but the intensity of flint use is lower, with a higher proportion being marginally or opportunistically used (flint 12%, chert 6%).
- 6) Chert retouched pieces are more frequently used than flint retouched pieces (chert 33%, flint 18%). The edge-damaged pieces are the most frequently used, with a dominance by flint (flint 57%, chert 48%).
- 7) The most common type of motion is longitudinal. The scrapers all have transverse motions, and the microliths all have impact or longitudinal motions.
- 8) All positive evidence suggests the use of the microliths as projectile elements.

The flint appears to have been imported to the site in a ready knapped state. The differences between the two materials makes direct comparison difficult as there are essential differences in the technology used for their reduction. The apparent higher proportion of flint blades suggests that flint may have been perceived as the better material for

blade manufacture. However, the use rate of the flint suggests that it was not treated as a material with high value. An interpretation of this evidence is that the flint was part of the normal lithic repertoire of the site occupants, and was brought with them simply as part of an embedded process. The more portable and flexible pieces would have been transported from site to site. The types of material present, their quantity and their composition could reflect the raw material availability and knapping strategies of the group's previous location, helping in the reconstruction of regional systems.

Starr 1:

Starr 1 has a more complex site history than Smittons. In general it is considered as two sets of occupations, an earlier, represented by the excavated material, and a later, represented by the surface material. This undoubtedly oversimplifies the true situation. Unfortunately the sample for functional analysis was too small to be "period"-specific, so the functional information refers to the entire sequence of material.

- 1) Chert is the more frequent material (chert 52%, flint 48%), although this global figure masks a discrepancy between the earlier occupations where flint is more common at 56%, to the later when flint is only 21% of the material.

- 2) Chert cores dominate throughout the occupations. There are more than twice as many as flint even in the earlier, flint dominated, phase. The discrepancy is exaggerated by the nature of the chert and its "wasteful" technology. Because the flint is more heavily reduced, the scale of the discrepancy may be more apparent than real. However, the chert material on site probably only represents part of the chert reduction sequence, as Affleck recorded some preliminary breaking up of chert blocks at a separate site (Starr 3). Taken together the evidence implies that while the chert was knapped *in situ*, at least some of the flint was imported ready-knapped.

- 3) While blades are overall less common than at Smittons, the discrepancy between flint and chert is more marked, with 17% flint to only 10.5% chert.

- 4) A higher proportion of the flint is retouched (4.6% of the flint) than chert (2.7% of the chert).

- 5) The flint has a higher use-rate than the chert (62% to 46%), although this may be partially offset by the proportion of chert pieces with use-traces potentially obscured by NUW.
- 6) The use of flint is more intense than that of chert. Amongst retouched pieces the chert includes some marginally or opportunistically used pieces, while all the flint pieces are fully "used". The same pattern occurs with the unretouched sample, and there are only a small number of opportunistically used edge damaged flint pieces.
- 7) While the most common motion is longitudinal, there is a discrepancy between flint and chert. The flint is dominated by longitudinal or bidirectional longitudinal motions, while the chert is more evenly divided into longitudinal and transverse motion. There is, as at Smittons, a high correlation between transverse motions and scrapers, but microliths do not exhibit a uniform pattern.
- 8) None of the positive evidence on microliths suggests a projectile use. A range of motions is suggested, including bidirectional, transverse and piercing. The evidence for these is clear and includes such features as the rounding of edges, not likely to occur during projectile use.

The flint is again imported, probably at least partially in a ready-knapped state. While there are again difficulties in comparing flint with chert it appears that flint is the preferred material for blade manufacture. This may be partially explained by the preferential importing of blades rather than their manufacture, given that ready knapped material was imported which might include a high proportion of blades. However, the portability of blades in a ready-knapped state is marginal. The portability of a blade industry such as this lies in the advantages of transporting small prepared blade cores from which blades can be produced where and when needed.

The use rate of the flint is significantly greater than for the chert. It can therefore be suggested that at Starr the flint was perceived as a more valuable material, particularly valued for its greater lateral strength in longitudinal motions. It could be argued that functional differences between the two sites (as possibly demonstrated by the lack of evidence

for projectile use at Starr) could explain the differential value given to flint for particular purposes. This seems unlikely however, as a comparison of figs 18.2 and 18.3 will show that overall at Smittons the emphasis on longitudinal motions was greater than at Starr, and it is for these motions that flint was preferred at Starr.

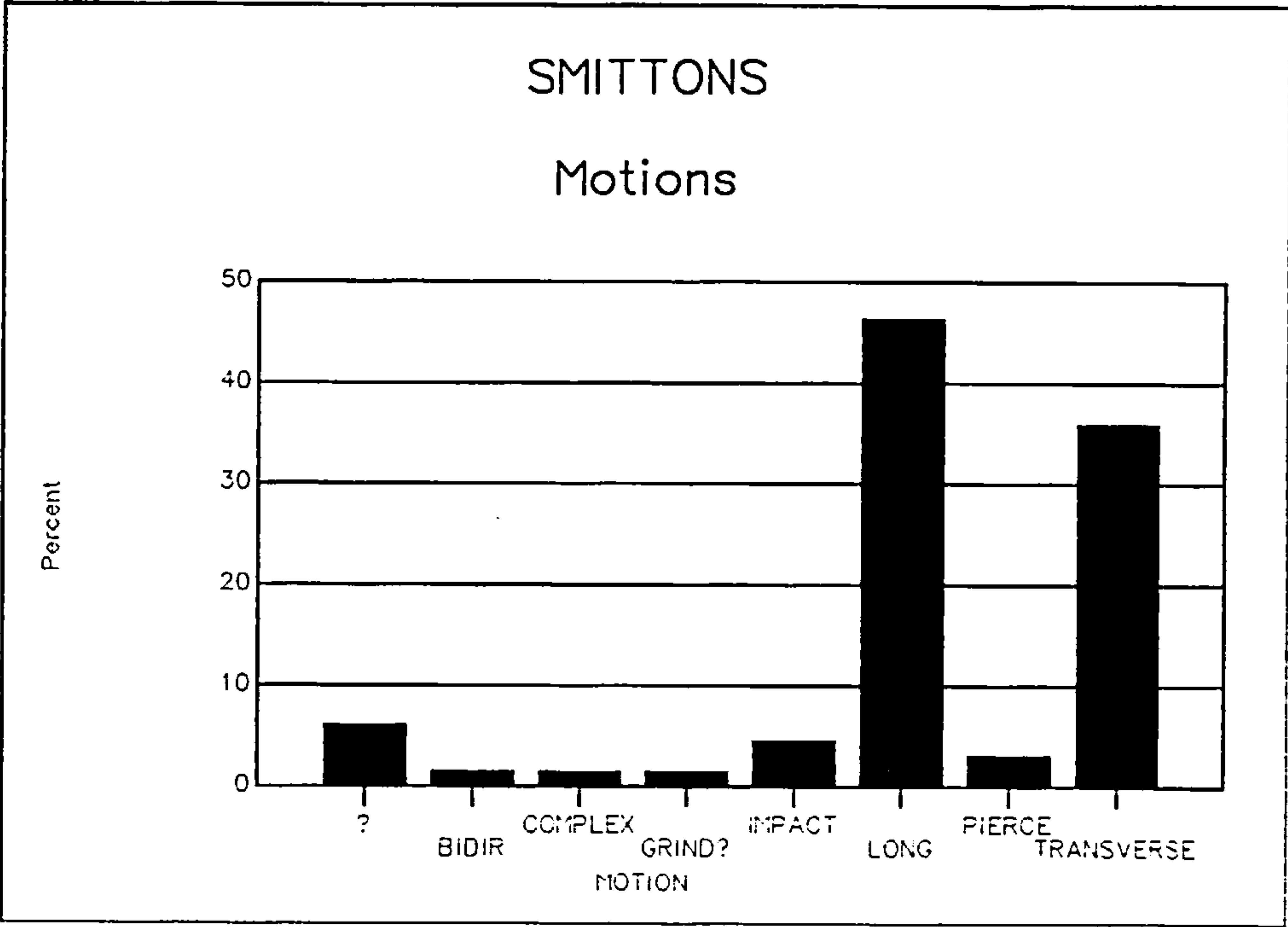


Fig 18.2

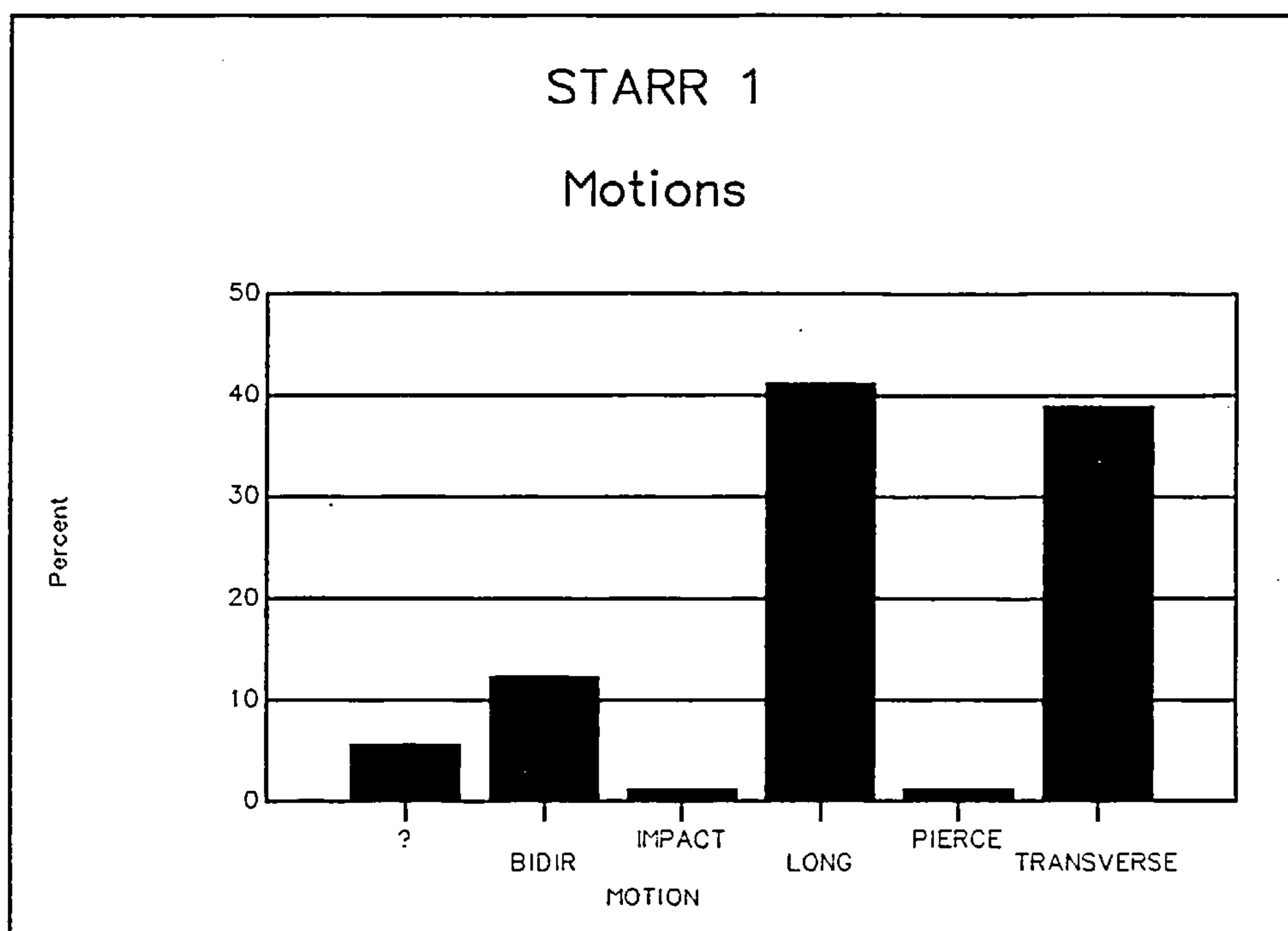


Fig 18.3

This variation in use-rates may be explained by patterns of mobility and territorial ranges. It may mean that flint was a rarer and therefore more expensive and valuable resource to the occupants of Starr.

Gleann Mor:

- 1) Nearly all the material used is flint, with only a very low proportion of quartz.
- 2) The technology is predominantly the result of the use of prepared platform cores, but there is a significant proportion of bipolar cores.
- 3) Although the overall assemblage is dominated by knapping debris, a comparison of the flakes and blades over 1cm in size suggests that the production of blades was an important activity (blades 21.5%, flakes 78.5%). Many of these larger flakes will be a byproduct of blade production.
- 4) Only a small proportion of the total assemblage is retouched, but of these, nearly half are microliths.
- 5) As at Starr, edge-damage is often a good indicator of use, but it is far from perfect.

- 6) There appears to be a relatively low use-rate of retouched pieces compared to unretouched pieces.
- 7) As at the other sites, longitudinal motions are more common than transverse motions, but only marginally, and with a wider range of more complex motions.
- 8) Out of the small number of microliths with wear-traces it appears that, as at Starr, they were used for a range of activities. At Gleann Mor this includes one example of probable projectile use.

Flint on Islay is relatively cheap, making its predominance understandable. The quantity of quartz present is by itself sufficiently low to suggest it had minimal or incidental importance, but the small sample includes some retouched pieces and there is in fact a greater proportion of retouched quartz than flint. It is hard to believe that this poor quartz would have been deliberately selected for the manufacture of retouched tools, so this may mean that the quartz represents the portable elements brought to the site from an area not so rich in flint. The large quartz component in the Jura industries can be cited as evidence of a potential source. This "importing" should be seen as the result of the transport of incidental baggage or the contents of "pockets". It is more likely that the plentiful and good quality flint from Islay was being deliberately exported. It is hoped that the linked research into raw material availability in the Southern Hebrides will help to elucidate these problems. The low use-rate on the retouched pieces may indicate that they were generally being made at Gleann Mor and curated for transport elsewhere.

Work on the Gleann Mor material continues, and is combined with work on other sites in the area. It is hoped that such an extension of work can also be made in Dumfries and Galloway, and indeed elsewhere in Scotland. This is essential as not only are the samples still small, but also because any work which examines mobile hunter-gatherers against a background of function and resource availability has to consider the regional perspective. It has to be acknowledged that the current state of research integrating the various aspects of the lithic evidence is in its infancy.

The Implications of functional evidence:

Rowley-Conwy (1987) has suggested that sites with no organic preservation should not be excavated, as lithic analysis has a poor methodology compared to faunal analysis. Indeed, his ecological approach appears to ignore most artifactual evidence. He has a major problem, as he hopes to reconstruct regional systems, while sites with good organic evidence (and he appears to mean primarily faunal evidence) are relatively rare. Their survival is not entirely random either, as it requires particular conditions to ensure the preservation of a complete set of faunal data. Rowley-Conwy admits that some sites, for example summer sites where plant foods were the major resource, will have extremely low visibility for ecological analysis. It can be suggested that Rowley-Conwy's systems are going to suffer from extreme biasing. In addition, without serious analysis of the artefactual material, it is impossible to investigate whether sites belong to one "system" or another. For example, analysis of reindeer bones may suggest exploitation along a migration path, but they will not indicate whether this exploitation is from static groups intercepting the migration, or from one group following the migration. It should be clear by the end of this section that lithic evidence can fill in these gaps.

Lithic studies have never been short on method; what has perhaps been missing is the theoretical basis for using that data in detailed archaeological interpretation (Torrence 1983). Torrence has argued that while lithic analysis has become increasingly sophisticated, it has contributed little to the study of human behaviour. She points out that most archaeological theories of behaviour are based either on anthropology or ecology, and therefore ignore the bulk of the archaeological evidence (Torrence 1989).

At the same time real use of lithic data has always been hampered by the lack of a practical method for analysing the function of the tools. The rather fruitless Mousterian debate indicates how, without having any independent functional data, it is very hard to do other than theorise on the role of items which above all other considerations have to function as tools.

The development of the technique here has contributed to solving the functional problem. The relevance of raw material was brought to the fore by the variability seen in the material analysed. At the same time as this project was being undertaken there have been significant developments in the use made of lithic evidence. The concepts introduced by Binford, curated and expedient tools, embedded and logistic procurement strategies, have been developed and refined (Binford 1976, 1979). Torrence (1983, 1989) has developed principles of time budgeting with regard to the manufacture and use of stone tools. Bleed (1986) has expanded the concepts of expedient and curated by using the engineering principles of reliable systems and maintainable systems. He demonstrated that although reliable systems are expensive, where failure costs are high but time is available in predictable amounts, they can represent a design solution to an economic problem. He uses the Nunamiut Eskimos as an example of a group who spend considerable "down-time" manufacturing and maintaining tools for periods of seasonally predictable hunting. Where there is an unpredictable schedule and a fairly continuous need, a cheap and easily maintained system will be used (Fig 18.4). His example for this is foraging societies, like the !Kung.

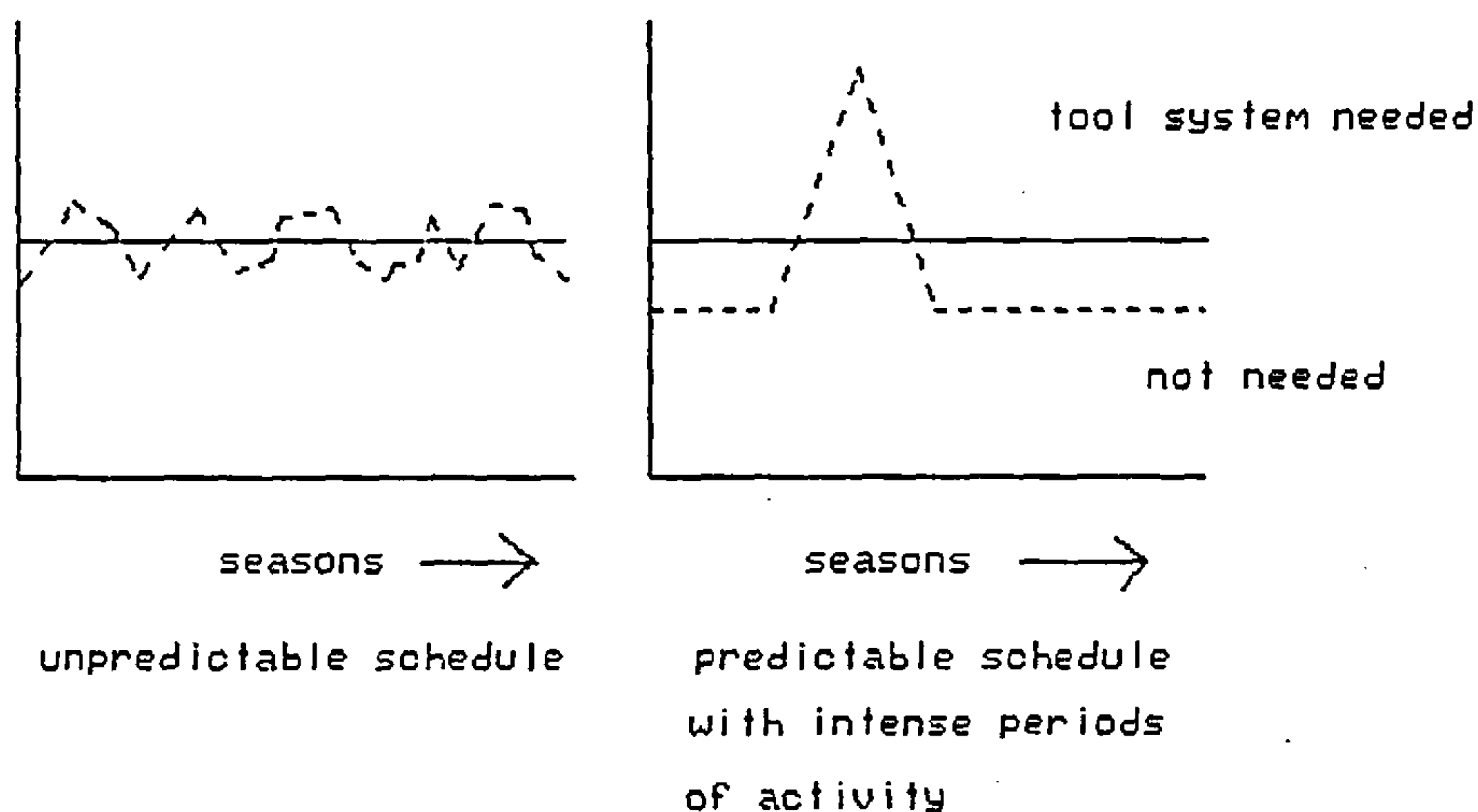


Fig 18.4 Variability in need for tool kit during a year (After Bleed 1986)

Other workers have stressed other variables such as raw material (Hayden 1989, Camilli 1989, Jeske 1989), technology (Kurie 1989), cost-benefit analysis (Boydston 1989), and symbolic information (Gero 1989). With the exception of the last, all these have used optimal theory, but concentrated on these various aspects as the currency to be optimised. Zvelebil (1984 and 1986) and Myers (1987 and 1989) have both attempted to use this approach with regard to the Mesolithic. Myers in particular has concentrated on the British Mesolithic, with technology as the currency to be optimised.

The technique developed here has suggested new avenues for research, when applied as a part of an integrated approach to the lithic evidence in total. It may be possible to isolate variations in site functions across the environment, but equally interesting is the possibility that the relationships between different types of assemblages may be examined. Having some functional data makes it possible to test theories of technological and material optimisation. Some of the simplest functional information, for example the use-rate, can illuminate the perceived values of raw materials, degrees of curation, and stress on material availability. In addition, by examining functional data, it may become more clear what variables are important stylistically. Differences between type and sub-type can be examined by function as well as style. The two dimensions cannot, however, be perceived as opposed or exclusive.

Microlith Style:

The relationship between function and style is complex. If microliths represented a single category of tool function then it might be considered that all variation was stylistic. The evidence suggests that this is not the case and that several other factors have to be considered. Microliths appear to have several possible functions, and, although the analysed sample is as yet far too small to allow investigation of this aspect, it is possible that some variations in form were functionally determined. This refers, of course, to variation within trends. There is no suggestion here that the basic division of broad blade Mesolithic and narrow blade Mesolithic forms are not valid as chronological markers.

Although this project has been primarily concerned with establishing functional information, it must be remembered that function is not the only design criterion for a tool. Gero has noted the tendency to assume that artifact form follows directly from environmental and subsistence needs, and suggests that instead the makers of the artifacts can be more directly involved using "material culture not merely to subsist but also to form, maintain and transform social relationships" (Gero 1989: 92), consciously or unconsciously.

The precise meaning of any stylistic messaging from microliths is hard to evaluate. Microliths do not have high visibility, even those used as armatures. If hafting reconstructions and interpretations of wear traces are reasonably accurate, then not only is their small size a problem, but most of the piece has to be hidden by hafting, and the area most often concealed appears from the functional data to be the area with distinctive retouch.

The economy of a microlithic tool-kit:

Myers has put forward the interesting idea that the adoption of small microlith types in the late Mesolithic is a response to changing hunting patterns. In his latest statement of this case (Myers 1989) he puts forward a convincing argument. Part of its strength is that it is based upon the integration of a combination of evidence from climate, ecology, settlement and lithic strategy. The hypothesis is that the appearance of late Mesolithic microliths replacing the large early Mesolithic microliths and bone points marks a change in subsistence activities related to climatic change. In essence he argues that, with climatic amelioration and less marked seasonality with reduced temperature differential between upland and lowland, there was a decrease in deer migration. As a consequence hunting could no longer be based on the prediction of migration routes or deer yarding, concentrating animals into specific places at specific times. This meant that hunting strategies had to become more opportunistic. Hunters had to be constantly ready to hunt a variety of game. As evidence for this Myers cites the apparent increasing use of the landscape with numerous small Mesolithic sites, as opposed to the larger, but less common, early Mesolithic sites. In

addition, following Torrence's development of time stress in lithic technologies (Torrence 1983), he suggests that the shift to microlith-barbed arrows from bone points is because a portable blade-core/microlithic technology is more maintainable than bone/antler points. The repair of the latter is impossible, and replacement requires both much time and a plentiful supply of the material. The late Mesolithic therefore has a more maintainable technology, which is more appropriate for persistent irregular hunting than the early Mesolithic where it would have been easier to schedule tool manufacture and repair between predicted hunting activities.

In addition to the maintenance advantages, Myers suggests that the increased numbers of barbs per arrow in the late Mesolithic would have increased the reliability of projectiles from early Mesolithic microlith-barbed arrows by component redundancy. Rather than seeing reliability and maintainability as two dichotomous possibilities (Bleed 1986), Myers believes that they are two related variables which can be combined.

This combination provides the best of both situations as it provides a reliable technology that can be used at short notice without repair, but that whenever some time does become available, maintenance can be undertaken without the need for specialised resources. He argues that this is the result of a context where subsistence and technological schedules could not be scheduled in advance, but where risk levels were high and consequently reliability was needed. The increased use of local materials (noted by Jacobi in the Pennines, but simply explained as increased local knowledge following a reduction in annual territory (Jacobi 1987)) is a reflection of the expedient nature of repair and replacement of raw materials, which had to be embedded into the subsistence strategy.

This argument is very plausible in its detail and incorporation of numerous independent variables. There are however a number of problems.

- 1) It ignores the stylistic dimension.
- 2) It assumes a uniform function for microliths.
- 3) It assumes a uniform pattern across Britain.

- 4) It assumes that the reasons for herbivore migration are simple.
- 5) It assumes that the hunting of large herbivores was the primary means of subsistence.

These problem areas can be considered one by one:

Style: It has already been stated that style has potentially great importance in tool form. It is sufficient here to note that Myers ignores style completely.

Function: The evidence from wear traces in the case studies has shown that microliths do not have a uniform function. Indeed, the scenario put forward by Zvelebil is extremely unlikely. He envisages that it would be possible to conduct "retooling during the hunt" and that "If game was sighted, the small stone blades could in a very short time be reshaped for capturing that prey" (Zvelebil 1986). Presumably the microliths would also have to be rehafted. This misses the point of the maintainable tool kit which should always be ready for use with a minimum amount of work. It also ignores the possibility of reliability through component redundancy.

While many microliths may represent projectile use, it is clear that they have other uses, probably as knives and piercers or drills. In addition there is a more general fault. One of the reasons for the association of microliths with hunting has been the association of microliths with small upland sites or isolated find spots. There is another type of site that is rich in microliths, Mellars B1 type (Mellars 1976), generally coastal or island sites, such as Kinloch Farm on Rhum, Gleann Mor on Islay, and Lealt Bay on Jura. These sites are unlikely to represent the results of an "encounter hunting" strategy.

Pattern: While the distribution of microlith-rich sites varies across the landscape, the landscape itself changes. While Myers puts forward the case of reduced need for deer migration due to reduced seasonal and altitudinal differences it is unlikely that this case holds good for the entire island. Partly as the result of latitudinal increase (moderated by oceanic climate), and partly due to the increased topographic variability,

there may well have been a higher incidence of migration in the North of Britain than in the South.

Migration: The model that Myers puts forward for the migration of herbivores is somewhat simplistic. The only motives put forward are the results of seasonal temperature changes. There are several objections to these. One is that the climatic situation varies throughout Britain, as a result of varying local conditions, such as topography. In the north of Britain there is generally greater relief than in the south, and this is combined with increased seasonality caused by higher latitude. In addition the motives for herbivore migration are more complex than Myers implies. Other factors can also be important, these include parasite infestation, carnivore avoidance, and the exhaustion of local resources. There is little evidence for patterns of deer migration in either the early or the late Mesolithic. There is no evidence for the extreme yarding behaviour that occurs in Norway with both far more pronounced relief and seasonality at any time in the post-glacial period.

Subsistence: The economic structure that Myers presents as the basis for change in tool-kits is biased towards the hunting of large terrestrial mammals. It assumes that these formed the primary source of food in the late Mesolithic, and that changes in mammal behaviour would have determined a specific response. There are other alternative strategies that could be pursued, and alternative food sources to exploit. Myers' builds an entire socio-economic model from microlith function. This depends upon the assumption that large ungulate hunting must have been the primary food source.

An alternative economic strategy for North Britain:

If it can be accepted that microliths did not always function as projectile armatures, and that deer hunting was not necessarily the primary form of subsistence activity, it is possible to construct an alternative economic strategy, that at least in the North of Britain fits the evidence somewhat better. This is of course very tentative, as the detailed analysis of patterns of lithic exploitation is based on only three sites.

First it has to be noted that there are a number of resources that remain predictable in their movement, these include anadromous fish (such as salmon), sea fish (such as mackerel), waterfowl (such as geese) and seals. Aquatic resources could have provided a substantial component to the diet (cf Zvelebil 1986, Rowley-Conwy 1987). This has three possible effects.

- 1) The pressure caused by the increased risks of an encounter hunting strategy would have been substantially less, as the aquatic resources would have remained predictable.
- 2) The scheduling of activities could still be maintained allowing tool manufacture and maintenance to be segregated from subsistence activities.
- 3) It could increase the importance of coastal/riverine locations to the economy.

Evidence for such an economy does exist. The importance of coastal/riverine location in the Mesolithic in Scotland has been noted (Morrison and Bonsall 1989). While there is probably some bias in the discovery of sites, nearly all of the Mesolithic in Scotland is either located on the coast (at Morton, along the Solway and Clyde firths, or on the western islands) or along river systems (the Tweed and the Dee). The distribution of sites in the South-West also appears to be concentrated around lochs and rivers.

This bias of settlement strongly suggests that some use was being made of aquatic resources. There is further evidence for such a pattern in the Obanian, where the shell middens contain fish and seal bones. The Obanian also includes bone and antler barbed points, **reliable** rather than **maintainable** tools. These suggest that for the "Obanians" at least, time budgeting was possible, allowing the scheduling of tool manufacture.

The relationship between the Obanian and the narrow blade microlithic Mesolithic is unclear at present, although the new dates available suggest that they are at least partially contemporaneous (Bonsall and Smith 1989). The microliths from Risga hint at further connections. The two assemblage types may represent functionally distinct aspects of one adaptation. It is hoped that it will be possible to examine the lithic

material from Oronsay in the near future to allow a functional analysis to be made.

There are some obvious dichotomies arising from this interpretation. One is the dichotomy within the Obanian between the reliable organic tools, requiring a high investment of time, and the bipolar lithic component. In the context of the Mesolithic this type of lithic reduction technique is best explained not simply as a means of dealing with small pebble resources, as these same resources are worked by the prepared blade core method, but as a low cost **expedient** technique.

The second dichotomy is between the Obanian and the narrow blade industries. While it may be hypothesized that they represent two functionally different aspects of the economy, they both share coastal distributions. The rejection of the principle that microliths always equal hunting combined with this distribution pattern suggest that the intuitively simple hypothesis that the Obanian represents the aquatic and the microlithic assemblages represent the terrestrial components of the subsistence technology cannot be held.

One solution to the dichotomy is not to regard the Mesolithic in the North of Britain as a simple hunter-gatherer-fisher system. Bonsall has demonstrated the potential for permanent occupation around the Eskmeals area in Cumbria (Bonsall 1981) and similar scenarios could be envisioned for many other coastal sites. These sites could then fall into Rowly-Conwy's category of complex hunters (Rowly-Conwy 1987). While the total resource base may have been greater for the Ertebolle economy on the continent, a range of subsistence resources would have made a similar, but smaller scale, economy possible on the West coast. This hypothesis, while moving still further from Myers' hypothesis of hunters under stress, changes the entire understanding of the settlement pattern. It can be argued that the microlithic sites on the coast represent generalised base camps, while the inland sites and Obanian sites represent task camps. If it is accepted that shellfish, while reliable, are not a very efficient form of energy to collect, then it can be proposed that shell middens may be the result of specific needs, rather than evidence for the primary subsistence mode. However without the midden neither the distinctive elements of the Obanian (the organic tools) nor the

economic data are likely to survive. The one element with a high survival potential is the bipolar technique and this is frequently found associated with microlithic industries (although sometimes its popularity, as with the quartz on Jura, is exaggerated by the technological needs of a particular raw material). It is likely that we would not recognise an Obanian site without the shell midden.

The reason for employing the bipolar technique can perhaps be found in the idea that Obanian sites were fish processing sites. If a large catch of fish was made, with the intention of storing the fish to be consumed later (possibly during a period of low subsistence activity and high technological activity), then an enormous quantity of processing would need to be done rapidly. Hayden notes that the North West coast Indians used ground slate knives to process vast quantities of salmon, as the quantity of material for chipped stone tools becomes prohibitive (Hayden 1989). An alternative strategy is to use the bipolar technique which produces vast quantities of small sharp flakes, all that is really needed for fish processing. Flenniken noted that this low cost option was also used for fish processing on the Northwest coast (Flenniken 1980). In other words, if it is the flakes and not the "cores" that are the desired end product, the bipolar technique allows rapid production of quantities of flakes without using prohibitive quantities of material. In addition, because of its nature, the technique allows inferior materials to be used for the same purpose, extending the supply of raw material.

This is in contrast to statements that the bipolar technique, because of its lack of control, is inefficient in terms of material use. Again, if it is the small, flat flakes, and not the "pieces ecaillees" or cores, that are the desired tools, then the technique is efficient. Indeed, while the blade technique is efficient once the core is made, the initial preparation, platform maintenance, and final unusable core all involve waste.

This leaves the microlithic evidence. The functional evidence would suggest that there are a variety of functions for microliths. This does not have to contradict Myers' basic idea of tools that combine both reliability by the use of multiple components and maintainability through the use of standardised lithic components. The microlith can be perceived as a standard element in a number of tools, where the

variation would be in the haft form and in the method of hafting the microliths. The same microlith could be mounted in either a knife handle or on an arrow shaft. This increases both portability and flexibility. The shaft/handle is, unlike the microlith, the element that requires scheduled manufacturing time, and is less easy to maintain (Myers omits to include the need to schedule time to make shafts in his hypothesis). However the shaft/handle has a potentially longer life-span than the working edge. Microlithic armatures will tend to fall out of their hafts, while knife blades will tend to grow dull or snap. In addition the shaft/handle is the element that will be most difficult to transport. It will be easier to transport spare microliths, or a blade core, than a set of handles.

The microlith can therefore be seen as a **maintainable** element in a variety of **reliable** tools. It does not by itself indicate hunting. The other element in the use of such standardised elements produced on narrow blades is that they are very efficient in terms of raw material. There is an investment in time and in skill in the production of a blade core. There is also a minimum quality of material that can be used to produce blade cores.

There should therefore be a trend to produce blades in the materials with higher perceived technological value. The evidence from Smittons and Starr suggests that flint is the preferred material for blade manufacture. It was suggested that different use-rates of blades at the two sites might indicate differing perceptions of the value of the material. Alternatively, it has been suggested that it is the blade core, with its associated input of time, that is expensive. Once made, the blades are relatively cheap to produce and "the economising behaviour is in the production of blades and not in heavy use of them once they are produced" (Jeske 1989). This is not true. While the high energy input will have been put into the production of the core, and little additional energy will be required to remove the blades, if the material used for blade manufacture is rare, and blades are a required element, then the blades will have a value from the material used, not from the required energy (fig 18.5). There is little value in economising on the production of blades from valuable materials unless those blades are worth the

effort. It can therefore still be suggested from the differential use rates that raw material values appear to differ between Starr and Smittons.

In the light of the overall economic argument put forward, a more precise reason for such variability in value can be seen. If a complex hunter society is developing, then increased sedentism will be a result. This will increase the discrepancies between the resources available to different groups. Within the constraints of the available resources lithic procurement can still remain embedded or logistical. Whether there is true sedentism or merely a reduced degree of movement, any reduction in movement is likely to reduce both the number of potential lithic sources and the possibility of embedding procurement within the subsistence strategy.

Cost of artifact production (after Jeske 1989)			
Artifact	Material Cost	Manufacture Cost	Total Cost
Expensive blade core	3	3	6
Expensive blade	3	1	4
Inexpensive blade core	1	3	4
Inexpensive blade	1	1	2
Expensive flake	3	1	4
Inexpensive flake	1	1	2

Fig 18.5

Jeske gives some hypothetical relative costs for different products. In this table it can be seen that as suggested above, and *contra* Jeske's own hypothesis, that blades made from inexpensive raw materials are cheaper as a finished product than blades made from the expensive material. Costs will vary for each group, depending upon the access each group has to material. It is therefore impossible to state that "flint is of greater value than chert". If flint is easily obtained then it will not be of substantially greater value. Therefore, if flint blades have an equal use-rate to chert blades, it can be suggested that for that particular group flint was plentiful. Depending on an individual group's access to materials, costs for raw materials will vary. It cannot be stated that "flint is more valuable than chert".

Morrow and Jeffries present a number of predictions that can be tested to examine the value of a material:

- 1) Non-Local-Material should come in a preformed or part-reduced state
- 2) Non-Local-Material should play a more specialised role
- 3) Non-Local-Material will be employed for "expensive" formal tools that can be resharpened
- 4) Non-Local-Material tools should exhibit curation characteristics
- 5) Non-Local-Material tools will be discarded only when exhausted or broken
- 6) Expedient tools will be made of the local material.

(Morrow and Jeffries 1989)

Only some of the above predictions have as yet been examined. It is important to note that in a hunter-gatherer situation non-local-material implies material for which a special effort has to be made. Material that is embedded within a mobile strategy is "local", although its use may fall off around an activity cycle. In this light prediction number one has a flaw. It omits the question of portability. A material, embedded in the mobile strategy but not regarded as "expensive", will tend to appear in the form of portable items away from its source. In other words, only the retouched pieces, preformed blade-cores etc will tend to move a lot. The set of predictions has to be used as a set, not as individual clues. There are in effect two issues here: 1) whether a material is preferentially selected for particular purposes, and 2) whether that material is more expensive in procurement costs.

Despite the proximity of Starr and Smittons and the relative ease of travel along stream routes through the area (cf Fig 14.3) it is possible that they belong to different "cycles". Smittons could belong to a Solway coast - upland round and Starr to an Ayrshire coast - upland round. Such a situation could explain differences in material use, and apparent material values. The occupants of Smittons may have had a good flint source embedded in their annual round, and may have simply carried some with them without treating it as a special material. The users of the Loch Doon sites may have had to procure the flint specially.

There are differences in the raw materials used along the Solway Firth. (Fig 18.6) Around Luce Bay flint is used almost exclusively, while a wide variety of materials are used in assemblages from the mouth of the River Nith. On the Firth of Clyde, Mesolithic assemblages at Girvan and Ballantrae are predominantly of beach flint, but include Arran pitchstone, quartz, chert and chalcedony. These variations may reflect not only local availability of materials, but also the availability of materials elsewhere in a group's round. The lack of chert from the Luce Bay sites may reflect a lack of seasonal mobility amongst Mesolithic groups in that area

Obviously there are several basic requirements if this approach is to be followed. It is essential that the availability of the various raw materials can be plotted over the landscape. It is essential that a good geographical sample of sites can be made. It is essential that the broad categories of material can be distinguished sufficiently easily to permit rapid classification and assignment to source. The resources must also be sufficiently restricted in their distribution to allow such sourcing. The material from each site needs to be classified in a reasonably uniform manner to allow inter-site comparisons to be made. A functional analysis must be made so that hypothetical values of raw material and artifact type can be empirically tested.

The current situation in Scotland is reasonably encouraging. There are a variety of materials used that are normally visually distinct (flint, chert, quartz, bloodstone, pitchstone, jasper and quartzite). Although each material may have more than one source, those sources are to some extent geographically distinct. It is for example possible to state that beach pebble flint comes from beaches, rolled chert comes from rivers and fresh chert nodules come from chert outcrops. Further recent research on raw material distribution has added more specific local detail to this pattern (Wickham-Jones in press, Finlayson and Sinclair nd), and more such work is in progress. In addition, there is now a substantial and increasing body of data on assemblages being produced in a standard manner, derived from that used on Rhum (Wickham-Jones in press). A functional technique has been developed that permits the

analysis of a number of different raw materials and experimental work has already been conducted on several of the most important materials in the area; pebble flint, chert and bloodstone. It will be necessary to extend this work to cover quartz and pitchstone, but this should be facilitated by other studies (eg Knutson 1988).

Kissonerga Mosphilia:

The study of material from Kissonerga Mosphilia represents an initial trial examination of a small sample. This sample will be extended, to allow more positive inferences to be made (a sample has already been cleared for export, but was unfortunately held up by a technical "hitch"). In addition a detailed study of the lithic technology is now being made by Carole Macartney which will provide much useful additional information.

The evidence from this study suggests that the limited typological analysis that such an assemblage allows is a very poor reflection of function. As a result the use of functionally derived classes of tool should be avoided where possible. In addition the attempt to cluster the poorly defined pieces together (particularly such types as the notched pieces), has little value other than the normalising of data. It is hoped that the increased sample will allow a more detailed analysis of the morphological traits, and enable a more meaningful analysis of typology. This is not to be done in terms of function, but by attempting to isolate those aspects of the morphology that are not purely functional in their origin.

Edmonds (1987) has put forward the theory that with the development of farming, the risks that a society faces are more long term than those for a hunter-gatherer. In other words, the hunter's tool-kit has an immediate effect on his ability to survive as it helps determine whether he hits or misses his quarry. The farmer's tool-kit has less immediate importance, as the crucial concerns to him are long term, will the rain come on time, will pests destroy his crop, etc. As a result less care need be taken in the manufacture of tools. This theory is used to explain the decline in tool quality in the Neolithic from the preceding Mesolithic in Britain. The

consequence of this is that Neolithic and later tool-kits are very hard to classify, as they consist of irregular, often poorly made tools. This theory can be used to explain part of the problems faced in classifying the Cypriot chalcolithic material.

Other aspects have to be considered too. The importance of the ground stone element for high quality tools has to be emphasised. Certainly for large scale wood working activities ground stone has a supreme advantage over chipped stone. Although it takes a high initial investment of energy, it can be sharpened almost indefinitely. This means that it becomes far more economical in terms of raw material when large quantities of work need to be done, and the cost of collecting sufficient raw material for enough chipped stone (cheap and replaceable, but relatively short lived) tools becomes prohibitive (Hayden 1989). This means that increasingly chipped stone tools will become used for more expedient purposes, and both the typology and functional data will reflect this.

In addition the importance of the chipped stone tools as symbols will tend to decline. Ground stone is a more plastic medium than chipped stone, but even ground stone does not compare with pottery as a medium for expressing cultural information (Gero 1989). It should be noted that the shift from subtractive to additive and more plastic media is not a simple shift, but a continuing process. Other factors will continue to influence the importance of objects, including expense (how rare a raw material is, the size of the item), the amount of time invested in production, the amount of skill involved, and the relative aesthetics of an object. This allows such objects as picrolite figurines to continue to be important. Flint tools are however made from a relatively cheap raw material and are being replaced technologically for some major and important tasks. In consequence they have less energy invested in them.

Jebel Naja:

The functional study of material from Jebel Naja is complete. It is hoped that it will be possible to examine a number of samples of burins from other burin sites, to see whether the functions of burins (as primarily

cores) are consistent from site to site. In addition the examination of burins will extend to other types of burin found, and to samples from PPNB and Late Neolithic contexts. The burin site type covers a wide area, and it should not be assumed that a single phenomenon is represented.

The implications of this work are very significant for the study of early pastoralists. In the analysis of stone tools there is a tendency to assume that tools are involved in either the primary subsistence activity, or in the manufacturing of tools and implements for that purpose. There are, of course, exceptions to this, but it is rarely recognised that a major part of a flint assemblage may be the results of "craft" activities. Indeed the burins occupy a stage removed from the visible craft, the drilling of beads. They are a production phase in the manufacture of tools to make the beads. Given that some of the other tools on the site will presumably relate to the manufacture/maintenance of the organic parts of the drill, it appears that the chipped stone evidence must in the main part relate to the bead manufacturing craft.

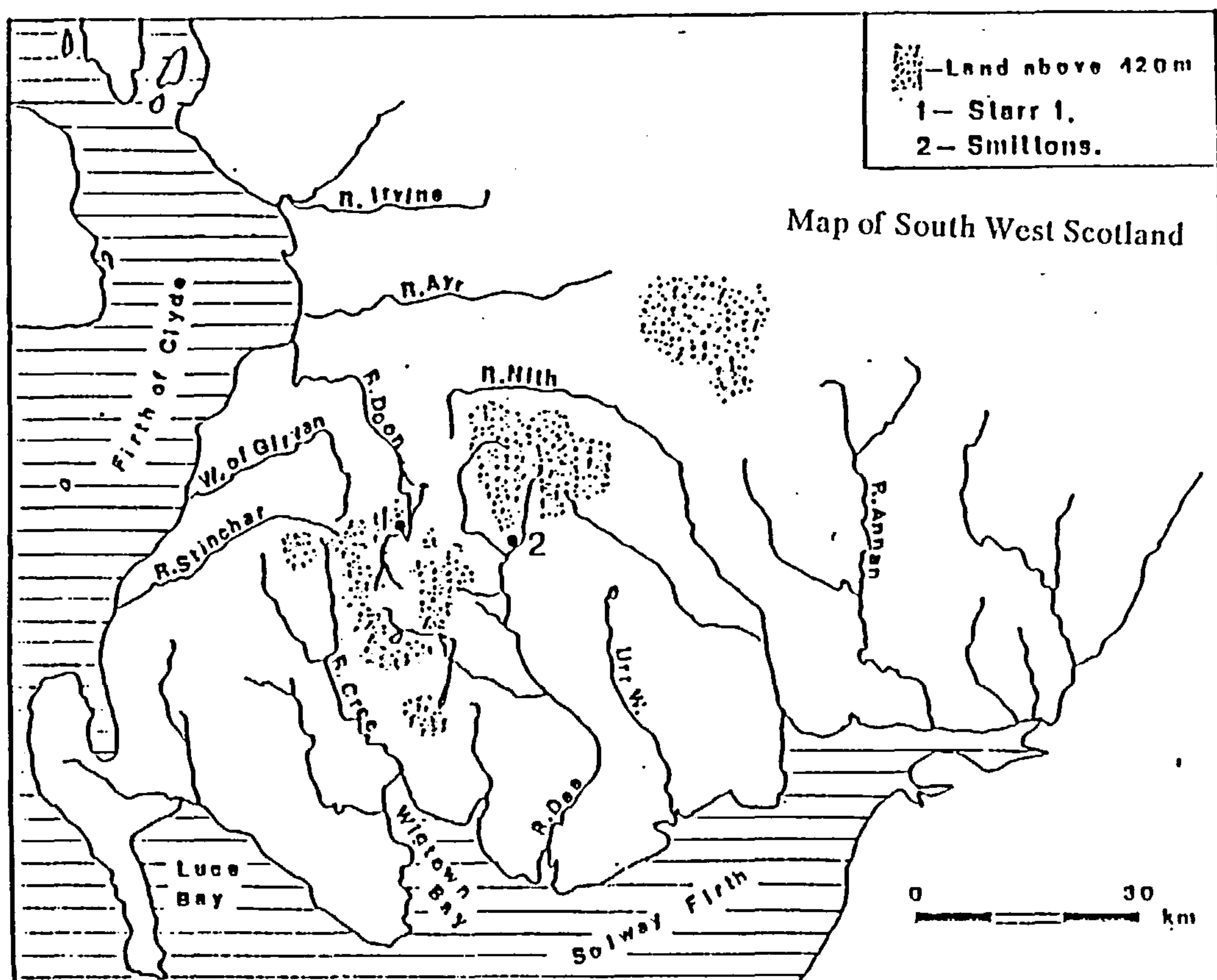
The significance of this lies in two parts. Firstly, it acts as a reminder that our understanding of stone tool use is very basic. Ethnographic analogies tend to be made with the more "primitive" tool users, and not with groups who support large craft industries. The "burin" as a typological category probably covers an extremely wide range of functions, whether they be cores as at Jebel Naja, elements for prehension and hafting, as at Kissonerga, a microlith production technique, as with microburins, or as "real" burins in the Upper Palaeolithic bone and antler working. Only direct functional analysis can possibly sort out the full variation in burin purpose.

Secondly, the functional evidence supports the hypothesis that craft activities would have been important to early pastoralists, as they are to modern pastoralists. Many pastoral societies supplement their subsistence with the agricultural products of their settled neighbours, and one currency they use is their craft work. If even a small fraction of the burin sites represent such craft activities it represents good evidence for the early development of such an economic link in the development of pastoral societies.

This work demonstrates the dangers of conducting a lithic analysis without the functional dimension, or the use of such a lithic analysis to develop theoretical models while assuming the function of tools. There is, however, no intention to replace typological analysis. Rather, what is sought is an integrated approach which examines all the strands of lithic evidence in combination to extract the maximum information possible.

This integrated approach is now being utilised in the analysis of Mesolithic material in Scotland. The method of functional analysis is also being applied to the analysis of technological strategies in the Neolithic of Orkney, at the sites of Pool (excavations of J.Hunter) and Tofts Ness (excavations of S.Dockerell). It is also being continued in analysis of Middle Eastern material. It is thought that the technique is sufficiently simple to allow any lithic analyst to be able to employ it, without excessive effort.

Fig 18.6



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Addenda

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Antiquity 33:62-66

Appendix A1

Experimental use of tools

Catalogue of experiments by material

Tweed Valley Chert

TVC 01	Chunk 41x19x15, used = thick Hide (elk), dry, cut, 5 minutes Hide (elk), dry, cut, 10 minutes Hide (elk), dry, cut, 10 minutes
TVC 02	Flake 52x43x10, used = med H.Wood (elm), seasoned, shave, 5 minutes H.Wood (elm), seasoned, shave, 10 minutes H.Wood (elm), seasoned, shave, 5 minutes H.Wood (elm), seasoned, shave, 5 minutes
TVC 03	Flake 26x23x4, used = thin Hide (elk), soaked, cut, 5 minutes
TVC 04	Flake 26x19x3, used = thin Hide (beaver), damp, dehair, 5 minutes
TVC 05	Chunk 22x10x7, used = point Shell, drill, 5 minutes
TVC 06	Blade Hide (beaver), damp, cut, 25 minutes
TVC 07	Flake 40x13x7, used = thick Hide (beaver), dry, scrape, 5 minutes Hide (beaver), dry, scrape, 15 minutes
TVC 08	Flake 26x22x5, used = thick H.Wood (elm), seasoned, whittle, 5 minutes H.Wood (elm), seasoned, whittle, 5 minutes
TVC 09	Flake 47x26x19, used = thin S.Wood (pine), seasoned, whittle, 5 minutes S.Wood (pine), seasoned, whittle, 5 minutes
TVC 10	Blade (microlith) Projectile (point), shot once
TVC 11	Flake (scraper) , used = thick Hide (beaver), soaked, scrape, 10 minutes
TVC 12	Flake (scraper).22x13x5, used = thick Antler (reindeer), dry, scrape, 5 minutes Antler (reindeer), dry, scrape, 5 minutes
TVC 13	Chunk 35x25x12, used = thick S.Wood (pine), seasoned, chop, 3 minutes S.Wood (pine), seasoned, scrape/plane, 5 minutes

TVC 20	Flake used = thin Hide (beaver), dry, cut, 5 minutes Hide (beaver), dry, cut, 5 minutes Hide (beaver), dry, cut, 5 minutes
TVC 21	Flake (part of TVC 20) Hide (beaver), dry, cut, c.5 minutes
TVC 22	Flake , used = thick Antler (reindeer), soaked, saw, 5 minutes
TVC 23	Blade 21x10x3, used = thick Antler (reindeer), soaked, gouge, 2 seconds (see TVC 53)
TVC 24	Flake 36x21x6 Trowelled Scalpeled
TVC 25	Flake 2x9x7 Scalpeled
TVC 26	Flake Wash test
TVC 27	Blade (microlith).8x2x2 Unused
TVC 28	Blade (microlith) 13x5x2 Projectile (barb), shot once
TVC 29	Flake 20x19x11 PDSM, damp sand, 30 minutes
TVC 30	Flake 29x12x5 PDSM, damp sand, 60 minutes
TVC 31	Chunk 39x17x17 PDSM, damp sand, 60 minutes
TVC 32	Flake 30x14x6 PDSM, damp sand + pebbles, 30 minutes
TVC 33	Flake 20x9x7 PDSM, damp sand + pebbles, 30 minutes
TVC 34	Flake 33x10x8 PDSM, damp sand + pebbles, 30 minutes
TVC 35	Flake 20x9x7 PDSM, damp sand + stones, 30 minutes
TVC 36	Flake 23x12x3 PDSM, damp sand + stones, 30 minutes
TVC 37	Flake 23x17x4 PDSM, damp topsoil, 30 minutes
TVC 38	Blade 23x11x5 PDSM, damp topsoil, 30 minutes
TVC 39	Core 42x25x15 PDSM, damp topsoil, 60 minutes
TVC 40	Flake 21x12x5 PDSM, damp topsoil, 60 minutes
TVC 41	Flake 25x17x12

	PDSM, damp topsoil, 60 minutes
TVC 42	Flake 24x12x8
	PDSM, damp topsoil, 60 minutes
TVC 43	Flake 22x12x9
	PDSM, dry sand, 120 minutes
TVC 44	Flake 22x13x7
	PDSM, dry sand + pebbles, 120 minutes
TVC 45	Blade 31x13x5
	PDSM, trampling, 18 months
TVC 46	Flake 25x23x7
	PDSM, trampling, 18 months
TVC 47	Chunk 20x10x7
	PDSM, trampling, 18 months
TVC 48	Core (scalar) 48x43x6, used = thick
	Hide (beaver), soaked, scrape, 5 minutes
TVC 49	Blade 16x2x2, used = point
	Antler (reindeer), dry, drill, 5 minutes
	Antler (reindeer), dry, drill, 5 minutes
TVC 50	Blade 34x15x9, used = med
	Hide (elk), dry, cut, 2 minutes
TVC 51	Flake (scraper) (48x30x12), used = thick
	Carcase (rabbit), butcher, 10 minutes
TVC 52	Blade 35x16x6
	Carcase (rabbit), butcher, 5 mins
TVC 53	Flake 10x10x3,
	Prehension (part of TVC 23)
TVC 54	Chunk 35x47x23, used =
	Carcase (rabbit), butcher, 5 mins
	Bone (fresh), chop, 2 mins
TVC 55	Chunk 18x11x2, used = thin
	Bone, fresh, shave, 5 minutes
	Bone, fresh, shave, 5 minutes
TVC 56	Flake 18x11x5, used = thick
	Bone, fresh, scrape, 5 minutes
	Bone, fresh, scrape, 5 minutes
TVC 57	Flake (scraper) 14x12x6, used = thick
	Hide (rabbit), fresh, scrape, 5 mins
TVC 58	Contact Experiment
	rub fresh bone, 50 minutes
TVC 59	Contact Experiment
	rub dry antler, 50 minutes
TVC 60	Contact Experiment
	rub soaked antler, 50 minutes
TVC 61	Contact Experiment
	rub soft leather, 50 minutes
TVC 62	Contact Experiment
	rub seas wood, 50 minutes

TVC 63	ex TVC 55 Bone, scrape, 8 minutes
TVC 64	Chunk (scraper), 20x19x14, used = thick Fish (trout), scale, 5 minutes
TVC 65	Blade 16x5x3 unused
TVC 66	Flake 18x13x5, used = thick Fish (trout), clean, 5 minutes
TVC 67	Core Crack Nuts (hazel), 5 minutes
TVC 68	Contact Experiment rub plant, 45 minutes
TVC 69	Contact Experiment rub cooked bone, 45 minutes

River Ken Chert

RKC 01	Blade 23x10x5, used = thick Hide (cow), dry, cut, 5 minutes
RKC 02	Flake 19x15x9, used = thick Antler (reindeer), soaked, groove, 5 minutes Antler (reindeer), soaked, groove, 5 minutes
RKC 03	Flake 31x21x8, used = med Antler (reindeer), dry, saw, 5 minutes Antler (reindeer), dry, saw, 5 minutes Antler (reindeer), dry, saw, 5 minutes
RKC 08	Blade 14x6x2, used = special Projectile, barb, shot once
RKC 09	Blade 11x5x2, used = special Projectile, barb, shot once
RKC 10	Chunk 25x14x10, used = med Antler (reindeer), dry, saw, 5 minutes
RKC 11	Blade 24x10x7, used = thick Antler (reindeer), dry, saw, 1 minute
RKC 12	Flake 19x20x5, used = thin Hide (beaver) dry, cut, 10 minutes
RKC 13	Flake 21x12x9, used = thick Antler (reindeer), dry, groove, 2 seconds
RKC 14	Scalar Core 46x40x20, used = thick H.Wood (elm), chop, 5 minutes H.Wood (elm), chop, 5 minutes
RKC 15	Blade 46x28x13, used = thick Antler (reindeer), dry, saw, 5 minutes Antler (reindeer), dry, scrape, 5 minutes

RKC 16	Flake 22x11x7, used = thick Antler (reindeer), dry, groove, 3 minutes Antler (reindeer), dry, groove, 5 minutes total = 320 strokes
RKC 17	Chunk Hide (beaver), dry, cut, 5 minutes Hide (beaver), dry, cut, 5 minutes
RKC 20	Flake 19x17x7, used = thick Hide (beaver) soaked, cut, 5 minutes Hide (beaver) soaked, cut, 5 minutes
RKC 21	Flake from RKC 20 Hide, < 5 minutes
RKC 22	Flake , used = special Wash Test
RKC 23	Flake 31x21x10, PDSM, damp sand 30 minutes
RKC 24	Flake 16x12x5 PDSM, dry sand + pebbles 120 minutes
RKC 25	Chunk 15x8x5 PDSM trampling, 18 months
RKC 26	Blade 30x15x8 PDSM packaging, 9 months
RKC 27	Blade 14x5x3 (microlith) Projectile (tip), shot once
RKC 28	Flake 17x14x4, used = point Shell, drill, 3 minutes
RKC 29	Flake 18x13x4, used = thick Bone, shave, 5 mins
RKC 30	Flake 8x14x4, used = med Hide (rabbit), softened, cut, 5 minutes
RKC 31	Flake 15x12x4, used = point Antler (reindeer), dry, drill, 5 minutes
RKC 32	Blade 10x3x2 (microlith) Projectile (barb), shot once
RKC 33	Blade 12x4x2 (microlith) Projectile (tip), shot once
RKC 34	Flake 10x7x7, used = thin Hide (rabbit), softened, cut, 5 minutes
RKC 35	Flake (burin) 11x7x2, used = bit(thick point) Antler (reindeer), dry, drill, 1 minute
RKC 36	Blade 35x17x16, used = thick Carcase (rabbit), butcher, 5 minutes
RKC 37	Contact Experiment rub soaked antler, 50 minutes
RKC 38	Contact Experiment rub dry antler, 50 minutes

RKC 39	Contact Experiment rub fresh bone, 50 minutes
RKC 40	Contact Experiment rub soft leather, 50 minutes
RKC 41	Contact Experiment rub seas wood
RKC 44	core Crack nuts (hazel) 5 minutes
RKC 45	Contact Experiment rub cooked bone, 50 minutes
RKC 46	Contact Experiment rub plant, 50 minutes

Loch Doon Chert

LDC 01	Flake 13x7x3 PDSM, packaging, 9 months
LDC 02	Flake 12x11x3 PDSM, packaging, 9 months
LDC 03	Flake 19x14x3 PDSM, packaging, 9 months
LDC 04	Flake 21x21x7 PDSM, packaging, 9 months
LDC 06	Flake 23x16x4, used = med S.Wood (pine), seasoned, whittle, 5 minutes
LDC 07	Blade 18x8x3, used = thin Antler (reindeer), soaked, groove, 5 minutes
LDC 08	Blade 18x8x3, used = point Shell, drill, 5 minutes
LDC 09	Flake (burin) 21x12x5, used = thick, used = point Bone, fresh, scrape, 10 minutes Bone, fresh, drill, 5 minutes
LDC 10	Blade 24x10x4, used = thin Hide, (fresh), cut, 10 mins
LDC 11	Flake 11x6x5 Prehension, snapped from LDC 09
LDC 12	Contact experiment rub fresh bone, 45 minutes
LDC 13	Contact experiment rub soft leather, 45 minutes
LDC 14	Contact experiment rub soaked antler, 45 minutes
LDC 15	Contact experiment rub dry antler, 45 minutes
LDC 16	Contact experiment

LDC 17	rub seas wood, 45 minutes Flake (scraper) Scrape beaver hide, 10 minutes
LDC 19	Contact experiment rub plant, 45 minutes
LDC 20	Contact experiment rub cooked bone, 45 minutes

Beach Pebble Flint

BPF 01	Flake (scraper) 22x19x5, used = thick Hide (rabbit), fresh, skin, 5 minutes
BPF 02	Blade (microlith) 11x4x2, used = point Shell, drill, 5 minutes Shell, drill, 3 minutes
BPF 03	Flake 21x14x5, used = point Antler (reindeer), soaked, drill, 5 minutes Antler (reindeer), soaked, drill, 5 minutes
BPF 04	Flake 19x20x5, used = thin Carcase (rabbit), butcher, 5 minutes
BPF 05	Flake (burin) 19x14x4, used = thick Carcase (rabbit), butcher, 5 minutes
BPF 06	Flake 13x25x5, used = thick Antler (reindeer), dry, scrape, 5 mins
BPF 07	Blade Projectile, shot once
BPF 08	Blade Projectile, shot once
BPF 09	Flake (scraper) 25x15x7, used = thick Hide (fresh), scrape, 5 mins
BPF 10	Flake (scraper) 18x13x3, used = thick Hide (fresh), dehair, 10 mins
BPF 11	Flake (nat backed) 21x16x3, used = thick Bone (fresh, scrape, 5 mins
BPF 12	Contact Experiment rub soft leather, 50 minutes
BPF 13	Contact Experiment rub seas wood, 50 minutes
BPF 14	Contact Experiment rub dry antler, 50 minutes
BPF 15	Contact Experiment rub fresh bone, 50 minutes
BPF 16	Contact Experiment

BPF 17	rub soaked antler, 50 minutes flake 18x10x7, used = thick Antler (soaked), groove, 5 mins
BPF 18	PDSM, damp topsoil, 60 mins
BPF 19	PDSM, damp topsoil, 60 mins
BPF 20	PDSM, damp topsoil, 60 mins
BPF 21	Flake 16x15x6, used = med Fish (trout), clean, 5 minutes
BPF 22	Core Crack nuts (hazel) 5 minutes
BPF 23	Core
BPF 24	Contact Experiment rub plant, 45 minutes
BPF 25	Contact Experiment rub cooked bone, 45 minutes

Guirdil Bay Bloodstone

GBB 01	Blade Seg 23x14x3, used = Med Leather (soft), Cut, 5 Mins
GBB 02	Flake 19x22x7, used = point Shell, bore, 5 mins
GBB 03	Flake 29x24x5, used = med Antler (Reindeer), dry, scrape, 5 mins
GBB 05	Flake 29x20x7, used = med Antler (Reindeer), soaked, groove, 5 mins Antler (Reindeer), soaked, groove, 3 mins
GBB 06	Flake PDSM, damp topsoil, 60 minutes
GBB 07	Flake PDSM, damp topsoil, 60 minutes
GBB 08	Chunk PDSM, damp topsoil, 60 minutes
GBB 09	Contact Experiment rub fresh bone, 50 minutes
GBB 10	Contact experiment rub soaked antler, 50 minutes
GBB 11	Contact Experiment rub dry antler, 50 minutes
GBB 12	Contact Experiment rub soft leather, 50 minutes
GBB 13	Contact Experiment

	rub seas wood
GBB 14	Contact Experiment
	rub plant (fresh green), 45 minutes
GBB 15	Contact Experiment
	rub cooked bone, 50 minutes

English Chalk Flint

ECF 01	Blade
	H.Wood (elm), seasoned, chop, 5 minutes
ECF 02	Flake (scraper)
	Bone (fresh), scrape, 10 minutes
ECF 04	Flake 33x24x5, used = thin
	Fish (trout), clean, 5 mins
ECF 05	Flake 21x15x2, used = thin
	Hide (fresh), dehair, 20 mins
ECF 08	Blade 25x7x2, used = point
	Hide (cow) dry, drill, 5 minutes
ECF 09	Blade 34x14x7, used = point
	Shell, drill, 5 minutes
ECF 10	Flake 45x41x12, used = med
	S.Wood (pine) seasoned, whittle, 5 minutes
	S.Wood (pine) seasoned, whittle, 15 minutes
ECF 11	Flake 37x47x12, used = thin
	Antler (reindeer), dry, saw, 5 minutes
	Antler (reindeer), dry, saw, 5 minutes
ECF 12	Flake 18x19x5, used = med
	Antler (reindeer), dry, shave, 5 minutes
ECF 16	Blade 57x25x7, used = thick
	Antler (reindeer), dry, scrape, 5 minutes
	Antler (reindeer), dry, scrape, 5 minutes
ECF 18	Blade (microlith) 19x6x3
	projectile, point, shot once
ECF 19	Blade (microlith) 24x7x4
	projectile, barb, shot once
ECF 20	Flake
	PDSM, damp topsoil, 30 minutes
ECF 21	Flake
	PDSM, damp topsoil, 30 minutes
ECF 22	Flake 23x32x5
	PDSM, dry sand, 120 minutes
ECF 23	Flake 29x25x5
	PDSM, dry sand, 120 minutes

ECF 24	Flake (double notch) 52x55x13, used = point Shell, drill, 5 minutes Shell, drill, 5 minutes
ECF 25	Blade (backed) 66x25x12, used = thick H.Wood (elm), seasoned, shave, 20 minutes
ECF 26	Flake 68x88x22, used = thick H.Wood (elm), seasoned, chop, 30 minutes
ECF 27	Flake 7x11x3, part of ECF 26 H.Wood (elm), seasoned, chop, 15 minutes
ECF 28	Flake (scraper) 51x95x21, used = thick H.Wood (elm), seasoned, scrape/plane, 25 minutes
ECF 29	Flake.....54x34x10, used = thin S.Wood (pine), seasoned, saw, 5 minutes
ECF 30	Flake (backed) 47x29x5, used = thin S.Wood (pine), seasoned, whittle, 5 mins
ECF 31	Flake 40x32x8, used = thick S.Wood (pine), seasoned, multiple (saw, whittle, groove), 40 minutes
ECF 32	Blade , used = thick Hide (elk), dry, cut, 15 minutes
ECF 33	Contact Experiment Rub soft leather, 50 minutes
ECF 34	Contact Experiment Rub seas wood, 50 minutes
ECF 35	Contact Experiment Rub dry antler, 50 minutes
ECF 36	Contact Experiment Rub soaked antler, 50 minutes
ECF 37	Contact Experiment rub fresh bone, 50 minutes
ECF 38	Blade, 73x32x8, used = med Stone (picrolite), saw, 15 mins Stone (picrolite), saw, 5 mins
ECF 39	Blade, 58x25x6, used = thick Stone (picrolite), saw, 5 mins Stone (picrolite), saw, 10 mins
ECF 40	Contact Experiment rub cooked bone, 45 minutes
ECF 41	Contact Experiment rub plant, 50 minutes
ECF 42	Truncation burin bone (fresh) groove, 5 mins
ECF 43	Truncation burin antler (dry) groove, 5 mins

ECF 44 Truncation burin
 antler (soaked), groove 5 mins

Cypriot Red Chart

CRC 01 Blade 51x19x4, used = thin
 Vegetable (soft), fresh, cut, 5 minutes

CRC 03 Flake 25x16x15, used = thick
 Stone (picrolite), saw, 5 mins
 Stone (picrolite), saw, 5 mins

CRC 04 Flake 33x23x8, used = thick
 Bone, fresh, scrape, 5 minutes

CRC 06 Flake 18x18x2, used = thin
 Stone (picrolite), saw + scrape, 20 mins

CRC 07 Flake 21x13x2, used = med
 Hide (fresh), dehair, 20 mins

CRC 08 Flake (backed) 21x16x3, used = thin
 Bone, fresh, shave, 5 minutes
 Bone, fresh, shave, 10 minute

CRC 09 Flake 76x43x12
 Split during retouch = CRC 23 and CRC 24

CRC 10 Flake 37x29x5, used = thick
 Hide (rabbit), fresh, cut, 10 minutes

CRC 11 Flake 19x11x3, used = thin
 Antler (?) soaked, groove, 5 minutes

CRC 12 Flake 31x21x6, used = thick
 H.Wood (elm) seasoned, plane, 5 minutes
 H.Wood (elm) seasoned, plane, 5 minutes

CRC 13 Flake 24x14x3, used = thick
 S.Wood (pine), seasoned, saw, 20 minutes

CRC 14 Flake 28x20x5, used = thick
 S.Wood (pine), seasoned, shave, 10 minutes

CRC 15 Flake 20x19x7, used = thick
 S.Wood (pine), seasoned, whittle, 5 minutes
 S.Wood (pine), seasoned, whittle, 5 minutes

CRC 16 Flake (scraper) 56x36x14, used = med
 Hide (beaver) soaked, scrape, 5 minutes

CRC 17 Flake 71x49x12, used = thick
 S.Wood (pine), seasoned, whittle, 25 minutes

CRC 18 Flake 58x38x8, used = thick
 Antler (?), soaked, saw, 5 minutes

CRC 20 Flake (backed) 47x31x9, used = thin
 Hide (Elk), dry, 5 minutes

CRC 21 Flake 31x16x3, used = med
 Antler (?), soaked, gouge, 2 minutes

CRC 22 Flake (scraper) 44x40x13, used = thick

	Hide (beaver) dry, scrape, 10 minutes
CRC 23	(CRC 09)
CRC 24	(CRC 09)
CRC 25	Flake PDSM, dry sand + pebbles, 60 minutes
CRC 26	Flake PDSM, dry sand + pebbles, 60 minutes
CRC 27	Flake 41x21 PDSM, trampling
CRC 28	Flake 41x20 PDSM, trampling
CRC 29	Flake 25x14x8 PDSM, dry sand, 120 minutes
CRC 30	Flake 18x10x5, used = point Ceramic, drill, 25 minutes
CRC 31	Flake 21x22x3, used = thick Stone (picrolite), scrape, 5 mins
CRC 32	Blade 21x8x3, used = thick antler (?), dry, scrape/shave, 5 minutes
CRC 33	Chunk 33x23x13, used = thick S.Wood (pine), seasoned, scrape/shave, 5 minutes
CRC 34	Blade 38x15x14, used = thick Bone (fresh), saw, 5 mins
CRC 35	Flake 56x53x12, used = med H.Wood (elm), seasoned, shave, 5 minutes H.Wood (elm), seasoned, shave, 10 minutes
CRC 36	Flake 66x40x19, used = med H.Wood (ash), seasoned, plane, 5 minutes H.Wood (ash), seasoned, plane, 10 minutes
CRC 37	Flake 38x43x7, used = med H.Wood (elm), seasoned, shave, 5 minutes H.Wood (elm), seasoned, shave, 10 minutes
CRC 38	Contact experiment Rub soft leather, 50 minutes
CRC 39	Contact experiment Rub seas wood, 50 minutes
CRC 40	Contact experiment Rub dry antler, 50 minutes
CRC 41	Contact experiment Rub soaked antler, 50 minutes
CRC 42	Contact experiment rub fresh bone, 50 minutes
CRC 43	ex CRC 31, 20x12x2, used = med Stone (picrolite), saw/scrape, 20 minutes

CRC 44	flake, 28x16x3, used = med Stone (picrolite), saw, 5 mins Stone (picrolite), saw, 10 mins
CRC 45	Contact experiment Antler (soaked), groove, 5 mins
CRC 46	Contact experiment rub cooked bone, 50 minutes
CRC 47	Contact experiment rub plant, 50 minutes
CRC 48	Flake, 36x35x10, used = med Horn (sheep), saw, 10 minutes

Grey Mottled Chert

GMC 03	Flake 79x39x15, used = thick H.Wood (Elm), seasoned, shave, 5 mins
GMC 04	Flake 36x22x8, used = med Stone, (picrolite), saw, 20 minutes
GMC 05	Flake 26x20x3, used = thick Hide (fresh), dehair, 30 minutes
GMC 06	Flake 87x52x19, used = thick H.Wood (ash), seasoned, chop, 5 mins
GMC 07	Blade 53x22x6, (broke on retouch, cf GMC 26), used = thin S.Wood (pine), seasoned, saw, 10 mins
GMC 08	Flake PDSM, damp sand, 30 minutes
GMC 09	Flake PDSM, damp sand, 30 minutes
GMC 10	PDSM, dry sand + pebbles, 60 minutes
GMC 11	Flake PDSM, dry sand + pebbles, 60 minutes
GMC 12	Chunk 29x19x14 PDSM, trampling, 8 weeks
GMC 13	Flake 38x24 PDSM, trampling, 8 weeks
GMC 14	Flake 47x26 PDSM, trampling, 8 weeks
GMC 15	Blade 54x23x7, used = med S.Wood (pine), seasoned, shave, 5 mins
GMC 16	Flake 29x21x8, used = point Stone (picrolite), drill, 20 mins also, used = thick Stone (picrolite), saw, 20 minutes
GMC 17	Flake 46x25x5, used = med

	Stone (picrolite), saw, 20 minutes
GMC 18	Flake 24x41x12, used = point
	Ceramic, drill, 35 minutes
GMC 19	Flake 11x14x4, used = point
	Ceramic, drill, 30 minutes
GMC 20	Blade 43x16x4, backed, used = med
	Vegetable (tuber), scrape, 5 minutes
GMC 21	Blade 32x10x5, used = point
	Shell, drill, 5 minutes
GMC 23	Blade 36x10x6
	Stone (picrolite) saw, 3 minutes
GMC 24	Flake 39x19x10, used = med
	Carcase (rabbit), butcher, 5 mins
GMC 25	Blade 25x5x4, used = point
	Hide (cow), dry, drill, 5 mins
GMC 26	ex 07
GMC 27	Contact Experiment
	Rub soft leather, 50 minutes
GMC 28	Contact Experiment
	Rub seas wood, 50 minutes
GMC 29	Contact Experiment
	Rub dry antler, 50 minutes
GMC 30	Contact Experiment
	Rub soaked antler, 50 minutes
GMC 31	Contact Experiment
	Rub fresh bone, 50 minutes
GMC 32	Contact Experiment
	rub cooked bone, 50 minutes
GMC 33	Contact Experiment
	rub plant, 50 minutes

Appendix A2

Experimental use of tools

Contact Experiments

All examined prior to rubbing to select flat areas, with no technological features already present to confuse data. All rubbed against contact material for 5, 15 and then 30 minutes with steady pressure. A straight backward and forward motion was used throughout. The contact area was kept the same for each cycle. All pieces went through each cycle of rubbing and examination at the same time to help ensure standardisation. All residue was left on material for a minimum of one week before washing to allow any chemical effects to take place.

Tool		Material	Face
BPF	15	Bone (Fresh)	Ve
CRC	42	Bone (Fresh)	Ve
ECF	37	Bone (Fresh)	Ve
GBB	09	Bone (Fresh)	Ve
GMC	31	Bone (Fresh)	Ve
LDC	12	Bone (Fresh)	Ve
RKC	39	Bone (Fresh)	Prox
TVC	58	Bone (Fresh)	Ve
BF	25	Bone (Cook)	Ve
CRC	46	Bone (Cook)	Ve
ECF	40	Bone (Cook)	Do
GBB	15	Bone (Cook)	Ve
GMC	32	Bone (Cook)	Ve
LDC	20	Bone (Cook)	Do
RKC	45	Bone (Cook)	Ve
TVC	69	Bone (Cook)	Ve
BF	24	Veg (Fresh)	Prox
CRC	47	Veg (Fresh)	Ve
ECF	41	Veg (Fresh)	Do
GBB	14	Veg (Fresh)	Ve
GMC	33	Veg (Fresh)	Ve
LDC	19	Veg (Fresh)	Ve
RKC	46	Veg (Fresh)	Prox
TVC	68	Veg (Fresh)	Ve
BF	12	Leather (Soft)	Ve
CRC	38	Leather (Soft)	Do
ECF	33	Leather (Soft)	Do
GBB	12	Leather (Soft)	Ve
GMC	27	Leather (Soft)	Ve
LDC	13	Leather (Soft)	Ve

Tool		Material	Face
RKC	40	Leather (Soft)	Ve
TVC	61	Leather (Soft)	Prox
BF	13	Wood (Seas'd)	Ve
CRC	39	Wood (Seas'd)	Ve
ECF	34	Wood (Seas'd)	Do
GBB	13	Wood (Seas'd)	Ve
GMC	28	Wood (Seas'd)	Ve
LDC	16	Wood (Seas'd)	Ve
RKC	41	Wood (Seas'd)	Ve
TVC	62	Wood (Seas'd)	Ve
BF	14	Antler (Dry)	Ve
CRC	40	Antler (Dry)	Ve
ECF	35	Antler (Dry)	Ve
GBB	11	Antler (Dry)	Ve
GMC	29	Antler (Dry)	Ve
LDC	15	Antler (Dry)	Ve
RKC	38	Antler (Dry)	Ve
TVC	59	Antler (Dry)	Ve
BF	16	Antler (Soak)	Ve
CRC	41	Antler (Soak)	Do
ECF	36	Antler (Soak)	Ve
GBB	10	Antler (Soak)	Do
GMC	30	Antler (Soak)	Ve
LDC	14	Antler (Soak)	Ve
RKC	37	Antler (Soak)	Ve
TVC	60	Antler (Soak)	Ve

Appendix A3

Experimental use of tools

Catalogue of material quality

Polish Test Pieces

ID	GRAIN	HOMOG	CRYSTAL	TOPOG	FISSURES	CONDITION
BPF12	F	H	A	F	A	F
BPF13	F	H	A	F	O	F
BPF14	F	H	A	F	C	F
BPF15	F	H	A	U	O	F
BPF16	F	H	A	F	O	F
BPF24	F	H	O	F	C	F
BPF25	F	H	O	R	F	F
CRC38	F	H	A	R	O	F
CRC39	M	H	A	U	O	F
CRC40	C	V	O	R	O	F
CRC41	M	V	O	R	O	F
CRC42	F	H	A	U	A	F
CRC46	M	H	O	F	A	F
CRC47	F	H	A	F	O	F
ECF33	F	H	A	F	O	F
ECF34	F	H	O	F	O	F
ECF35	F	H	O	F	O	F
ECF36	F	H	A	F	O	F
ECF37	F	H	A	F	O	F
ECF40	F	H	O	F	A	F
ECF41	F	H	O	U	O	F
GBB09	F	V	O	F	A	F
GBB10	F	V	O	F	A	F
GBB11	M	H	O	F	A	F
GBB12	M	V	F	R	A	F
GBB13	F	V	C	F	A	F
GBB14	M	H	F	F	A	F
GBB15	M	H	O	F	A	F
GMC27	F	H	A	F	A	F
GMC28	F	H	A	F	A	F
GMC29	F	H	A	F	A	F
GMC30	F	H	A	F	A	F
GMC31	F	H	A	R	A	F
GMC32	F	H	A	R	O	F
GMC33	F	H	A	R	A	F
LDC12	C	V	F	R	C	F
LDC13	M	V	C	R	O	F
LDC14	M	V	C	R	C	F
LDC15	C	V	F	R	O	F
LDC16	C	V	C	R	C	F

ID	GRAIN	HOMOGE	CRYSTAL	TOPOG	FISSURES	CONDITION
LDC19	C	H	C	R	F	F
LDC20	M	H	F	R	O	F
RKC37	M	V	F	R	O	F
RKC38	F	V	F	R	C	F
RKC39	C	V	F	R	C	F
RKC40	M	H	C	R	F	F
RKC41	M	V	O	R	O	F
RKC45	C	H	F	R	O	F
RKC46	F	H	A	F	O	F
TVC58	M	H	O	R	F	F
TVC59	M	H	O	F	F	F
TVC60	M	V	F	R	C	F
TVC61	M	H	O	R	O	F
TVC62	F	V	O	F	O	F
TVC68	C	H	C	F	C	F
TVC69	F	H	O	F	C	F

Key:

Grain: Fine, Medium, Coarse

Homoge (Homogeneity): Homogeneous, Variable

Crystal: Absent, Occasional, Common, Frequent

Topog (Topography): Flat, Rough, Undulating

Condition: Fresh, Burnt, Patinated, Abraded

Appendix A4

Experimental use of tools

Trace Reliability by Motion

ID	MOTION	TIME	POLISH	ED	STRIAE
-----	-----	-----	-----	---	-----
TVC01	LONG	5	C	C	A
TVC01	LONG	15	C	C	A
TVC01	LONG	25	C	C	A
TVC02	TRANS	5	C	P	C
TVC02	TRANS	15	P	P	C
TVC02	TRANS	20	P	P	C
TVC02	TRANS	25	P	P	C
TVC03	LONG	5	C	C	C
TVC04	TRANS	5	P	W	A
TVC05	CIRC	5	C	C	A
TVC06	LONG	25	P	C	A
TVC07	TRANS	5	P	A	A
TVC07	TRANS	20	P	A	A
TVC08	TRANS	5	C	C	A
TVC08	TRANS	10	C	C	A
TVC09	TRANS	5	W	C	A
TVC09	TRANS	10	P	P	C
TVC11	TRANS	10	C	A	A
TVC12	TRANS	5	P	C	C
TVC12	TRANS	10	C	C	A
TVC13	CHOP	3	P	C	A
TVC13	TRANS	5	P	W	C
TVC20	LONG	5	C	C	A
TVC22	BIDIR	5	C	C	A
TVC23	LONG	0	P	P	A
TVC48	TRANS	5	P	A	A
TVC49	CIRC	5	C	C	A
TVC49	CIRC	10	C	C	A
TVC50	LONG	2	P	P	A
TVC51	VAR	10			
TVC52	TRANS	5	W	W	A
TVC54	CHOP	5	P	P	C
TVC54	CHOP	7	P	C	C
TVC55	TRANS	5	A	W	A
TVC55	TRANS	10	W	P	A
TVC56	TRANS	5	W	W	W
TVC56	TRANS	10	W	W	W
TVC57	TRANS	5	P	A	A
TVC63	TRANS	8	W	P	A
TVC64	TRANS	5	A	A	A
TVC66	VAR	5			
RKC01	LONG	5	C	W	A
RKC02	LONG	5	C	A	A
RKC02	LONG	10	C	P	A
RKC03	BIDIR	5	P	P	A

ID	MOTION	TIME	POLISH	ED	STRIAE
-----	-----	-----	-----	---	-----
RKC03	BIDIR	10	P	C	A
RKC03	BIDIR	15	C	C	W
RKC10	BIDIR	5	P	C	A
RKC11	BIDIR	1	A	W	A
RKC12	LONG	10	C	C	A
RKC13	LONG	0	A	A	A
RKC14	CHOP	5	C	C	A
RKC15	BIDIR	5	W	W	A
RKC15	TRANS	5	A	W	A
RKC16	LONG	3	A	C	A
RKC16	LONG	8	W	C	A
RKC17	LONG	5	P	P	A
RKC20	LONG	5	C	P	A
RKC20	LONG	10	C	C	A
RKC28	CIRC	3	P	C	A
RKC29	TRANS	5	C	P	A
RKC30	LONG	5	C	W	A
RKC31	CIRC	5			
RKC34	LONG	5	C	P	A
RKC35	CIRC	1	A	A	A
RKC36	VAR				
LDC06	TRANS	5	W	C	A
LDC07	LONG	5	C	C	A
LDC08	CIRC	5	C	C	A
LDC09	TRANS	10	C	C	C
LDC09	TRANS	15	C	C	C
LDC10	LONG	10	C	C	A
BPF01	TRANS	5	P	A	A
BPF02	CIRC	5	A	C	A
BPF02	CIRC	8	P	C	A
BPF03	CIRC	5	P	C	P
BPF03	CIRC	10	C	C	C
BPF04	LONG	5	C	P	W
BPF05	LONG	5	P	W	W
BPF06	TRANS	5	C	P	C
BPF09	TRANS	5	C	C	A
BPF10	TRANS	10	C	A	A
BPF11	TRANS	5	P	P	C
BPF17	LONG	5	P	C	A
BPF21	TRANS	5	A	P	A
GBB01	LONG	5	C	C	A
GBB02	CIRC	5	P	C	A
GBB03	TRANS	5	W	P	A
GBB05	LONG	5	C	C	A
GBB05	LONG	8	C	C	C
ECF01	CHOP	5	A	P	A
ECF04	LONG	5	A	P	A
ECF05	TRANS	20	C	A	W
ECF08	CIRC	5	C	C	A
ECF09	CIRC	5	C	C	A
ECF10	TRANS	5	P	W	A
ECF10	TRANS	20	C	W	C
ECF11	BIDIR	5	C	C	P

ID	MOTION	TIME	POLISH	ED	STRIAE
-----	-----	-----	-----	--	-----
ECF11	BIDIR	10	C	C	C
ECF12	TRANS	5	A	A	A
ECF16	TRANS	5	P	P	A
ECF16	TRANS	10	P	W	A
ECF24	CIRC	5	C	C	A
ECF24	CIRC	10	C	C	C
ECF25	TRANS	20	C	P	P
ECF26	CHOP	30	C	C	C
ECF27	CHOP	15	P	C	W
ECF28	TRANS	25	C	C	P
ECF29	BIDIR	5	C	C	C
ECF30	TRANS	5	P	C	P
ECF31	VAR	40			
ECF32	LONG	15	C	C	A
ECF38	BIDIR	15	C	C	C
ECF38	BIDIR	20	C	C	C
ECF39	BIDIR	5	C	C	A
ECF39	BIDIR	15	C	C	C
CRC01	LONG	5	A	P	A
CRC03	BIDIR	5	C	C	C
CRC03	BIDIR	10	C	C	C
CRC04	TRANS	5	C	P	A
CRC06	VAR	20			
CRC07	TRANS	20	P	P	C
CRC08	TRANS	5	A	C	A
CRC08	TRANS	15	W	C	A
CRC10	LONG	10	W	C	A
CRC11	LONG	5	C	C	P
CRC12	TRANS	5	P	C	A
CRC12	TRANS	10	P	C	C
CRC13	BIDIR	20	C	C	C
CRC14	TRANS	10	C	P	A
CRC15	TRANS	5	P	C	A
CRC15	TRANS	10	P	P	A
CRC16	TRANS	5	W	A	W
CRC17	TRANS	25	P	C	W
CRC18	BIDIR	5	C	C	C
CRC20	LONG	5	A	C	A
CRC21	LONG	2	A	A	A
CRC22	TRANS	10	C	A	C
CRC30	CIRC	25	C	C	A
CRC31	TRANS	5	P	W	A
CRC32	TRANS	5	P	W	A
CRC33	TRANS	5	A	W	A
CRC34	BIDIR	5	C	P	C
CRC35	TRANS	5	W	W	A
CRC35	TRANS	15	W	W	A
CRC36	TRANS	5	C	W	A
CRC36	TRANS	15	C	C	A
CRC37	TRANS	5	P	P	A
CRC37	TRANS	15	P	P	A
CRC43	VAR	20			
CRC44	BIDIR	5	P	C	C

ID	MOTION	TIME	POLISH	ED	STRIAE
-----	-----	-----	-----	---	-----
CRC44	BIDIR	15	C	C	C
CRC45	LONG	5	C	C	A
CRC48	BIDIR	10	C	C	A
GMC03	TRANS	5	C	W	A
GMC04	BIDIR	20	A	C	A
GMC05	TRANS	30	C	C	P
GMC06	CHOP	5	C	C	A
GMC07	BIDIR	10	P	P	P
GMC15	TRANS	5	C	C	W
GMC16	CIRC	20	C	C	C
GMC16	BIDIR	20	C	C	A
GMC17	BIDIR	20	C	C	C
GMC18	CIRC	35	C	C	C
GMC19	CIRC	30	P	C	A
GMC20	TRANS	5	C	A	A
GMC21	CIRC	5	P	C	A
GMC23	BIDIR	3	C	C	A
GMC24	VAR	5			
GMC25	CIRC	5	P	C	A

Key:

Time: in minutes

C = correct

P = partially correct

A = absent

W = wrong

Appendix B

Recording Methodology

A serious problem with much research into wear traces has been the recording methods used. Of recent work only Plisson (1987), Grace (1988) and Hurcombe (1988) mention their recording methods. Ironically, Keeley's recording system appears from his published work to have been the most developed for edge damage. (Keeley 1980: 24) The descriptions used for polishes are however subjective.

One other recording system has to be mentioned. Vaughan and Plisson (1986) worked together to try to produce a standard recording system. However:

"Ce code n'enregistre évidemment pas la description brute des traces observées au microscope optique mais l'interprétation fonctionnelle qui en est faite par l'analyste." (Vaughan and Plisson 1986: 178)

In the terms of this present study this recording system is a level too high, the recording system needs to record the data *before* interpretation.

The system Keeley used for edge damage was, as is relatively common in "Low Power" studies, an attribute-based one. Recording of polishes has tended to lump attributes into types. Regardless of the final accuracy of any microwear study, reports that simply list wear in terms of "wood polish" and so on, prevent any second evaluation. As these polishes are complex phenomena, and the accuracy of such terms as "wood polish" is debatable, such terms cannot be used in this straightforward manner as simple descriptions.

In defence of the use of polish shorthand types, it may be argued that very little basic data can be re-assessed from any type of work. This argument misses the point. It should not be assumed that polishes are discrete phenomena. Much recent work (Vaughan 1985, Grace 1989 and here) suggests that they are in fact a continuous variable. For instance, while pollen grains are discrete items, each species different from another, they share many features in common. However, it can be assumed that a pollen diagram is essentially accurate, and that most grains were correctly identified. Argument however may occur over the interpretation of that diagram. This has little in common with the presentation of figures concerning "polish types". Polish development patterns (by virtue of the multitude of extraneous variables working on them, if for no other reason) are always different. It has always been recognised that they overlap to some extent, and that the differentiating features are not always clear and distinct.

In this project it was decided to develop an attribute recording system for polishes after initial frustration with the attempt to perceive standard, recognisable polish types. A

number of versions were tried and tested, the system being regularly revised and updated. Several basic criteria were used in the development process.

- 1) The system had to be kept as simple as possible. The purpose of using such a recording system would be lost if the system became too unwieldy.
- 2) The attributes had to refer to meaningful features. In other words the components that make up a polish had to be separated into clear and distinct attributes. There would be no point in using an attribute system to describe features that were not recurring elements. On the other hand, it had to be accepted that polish patterns were not discrete phenomena and that there would always be some areas of overlap. This had to be kept to a minimum.
- 3) The system had to be readily understood by other functional analysts. Obscure details were of no use, nor was it possible to include descriptive prose such as the famous "melting snowbank", or subjective details such as "greasy appearance". Ideally the system had to be simple enough to be understandable by anyone who was familiar with stone tool surfaces, without recourse to the guide sheets.
- 4) The system had to be workable. There would be no point in developing an attribute system if it were not a practical tool for analysis of trace data.

These basic points may seem self-evident, but when this project was begun no one appeared to be concerned with the poor methodology and recording techniques that prevailed. Having taken the decision to go back to the basics of polish features, and to work in a simple and straightforward manner, benefits began to appear that were not part of the four original criteria.

With a strict (and each version was increasingly strict) set of rules on the description of tools and their traces, comparison between tools and areas on tools became easier and more reliable. Ambiguous elements were removed in each version. Although some information was probably lost in some of the minor variations in detail that the system did not allow, each new version attempted to deal with any significant problems that had appeared in the last. It is possible, given the approach to the interpretation of wear data (chapter 9), that some details useful to a very "high powered" approach were lost.

The system meshed well with the basic research design of trying to develop a fast process. Because the rules were strict it was possible in the last versions of the recording system to switch to "multiple choice" record sheets. While room was always left for "comments" on the sheets, nearly all the relevant information could be entered by circling a box. This prevented any deviation from the main system, and speeded up the process considerably.

The recording System:

The basis for the recording system was a set of record sheets. The final version is shown here. The first sheet is the Item Sheet (Fig B.2), on which all the basic data

ITEM SHEET

ID

Prev Nos
Unique

Sheet Nos

Supp Sheets
Catalogued

Draw Nos

Photo Nos

Type

Material ID

Type

Source

Quality

Material

Surface
Grain F/M/C
H/V

Crystals
A/O/C/F

Topography
F/U/R

Fissures
A/O/C/F

Tool Data

Blank
B/F/Ch/Co
Retouch
Type

Dimensions

Edge Angle
a: b:
p: d:

Pre-Wash

Residue etc

Wash Method

Fig B.2

about an individual stone artifact is kept. The sheet fits into the experimental system as shown in Fig B.3. The same sheet was used for both experimental and archaeological pieces. With the record sheet goes the guide sheet that explains everything that has to be inserted.

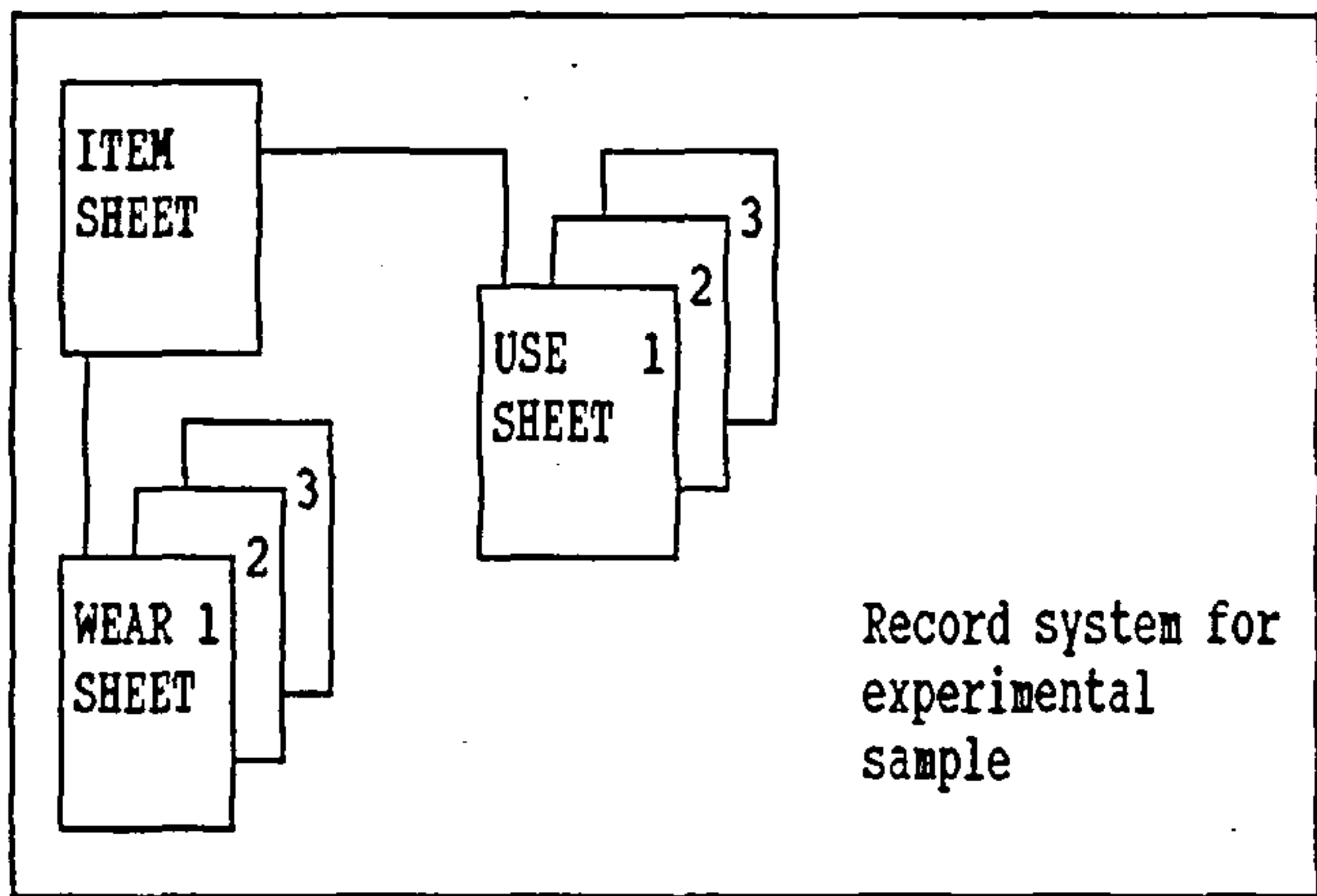


Fig B.3

Guide to item sheet

1: Item Sheet

- ID
- ID: Item Number
- Prev Nos:
- Sheet Nos:
- Supp Sheets:
- Draw Nos:
- Phot Nos:
- Type Arch/Exp:
- Drawing: (Display Material Variability)

Material ID

- Material: (C.Flint/B.Flint/Bloodstone/Scot Chert/Red Chert/Grey Mot)
- Source: (Ridgeway/Brandon/Denmark/Tweed/Ken/Loch Doon/Mavroko/Peia/Neophytas/Unknown)
- Quality: (Exc/Good/Med/Poor/Bad)

Material Surface

- Grain: Fine/Medium/Coarse
- Grain2: Homogenous/Variable
- Crystals: Absent/Occ/Common/Frequent
- Topography: Flat/Undulating/Rough
- Fissures: Absent/Occ/Common/Frequent

Tool Data

- Blank: (Blade/Flake/Chunk/Core)
- Retouch:
- Type:
- Dimensions: (LxBxT)
- Edge Angle: (Thick/Med/Acute/Point)
- (Repeat for (a,b,d,p))

Pre Wash

- Residue:

Wash Method:

Most of the above items are self explanatory. The *Item Number* is the unique identifying number given to every piece examined. The various number and sheet references are simply internal recording references and checks, only needed because during the course of this project the recording and numbering systems were changed several times. *Type* refers to whether an item was an archaeological or an experimental piece. *Drawing* is a reminder to make a sketch of the piece, primarily to locate any major variations in the material surface texture, the presence of flaw lines, and other such natural features.

The *Material ID* section gives the basic details of stone type, approximate source and a subjective description of quality, based upon both experience with knapping the various materials and with using them.

Material surface describes the surface texture and microtopography of the tool. Grain sizes were divided into three broad categories of fine, medium and coarse, with the reference point being fine, the normal grain of English Chalk flint. *Grain* was further described as either homogeneous or variable. If the area visible under the microscope at 50x was all of the same texture at several check points across the tool, then it was described as homogeneous, otherwise variable. (This tended to emphasise variability, except for the chalk flint pieces). *Crystals* refers to quartz crystals, a serious problem on some of the chert pieces. Absent means none, or a very few scattered over the item surface. Occasional means that between one and five were visible in each, or most, of the check points used to establish grain size. Common means that more than five were found in most reference points, and frequent means that in at least one of the check points crystals were ubiquitous, and that they were common in the others. *Topography* refers to the overall shape of the surface, flat refers to the typical flint surface, undulating means where the surface gently rolls and rough means where the surface is irregular. The last tends to be associated with coarse grain size, but the two features are not always directly correlated. *Fissures* refers to any cracks, ravines and so on that occur over the tool surface, their frequency is calculated as for crystals.

Tool data covers the basic morphology of the tool, if the tool is an experimental piece then it is possible to give more detail on the retouch and manufacture details. Dimensions of Length, Breadth and Thickness are all given in millimetres, and are taken at 90° to each other. Edge angle has been divided into three broad categories of **Thick**(>35°), **Medium**(15°-35°) and **Acute**(<15°). The irregularity and internal variation of edge angle on many of the pieces in the study meant that any attempt to give more precise measurements of edge angle would have been entirely spurious. **Point** is given to any aspect that terminates in a sharp point. The edge angle measurements are repeated for sides a and b (a on left side, tool oriented with proximal down, ventral down), proximal and distal ends. Although of course not all the pieces could be oriented according to this system in the strict sense of dorsal and ventral, proximal and distal (for example chunks), pieces were artificially given these aspects when first sketched, and the aspects remain constant from then.

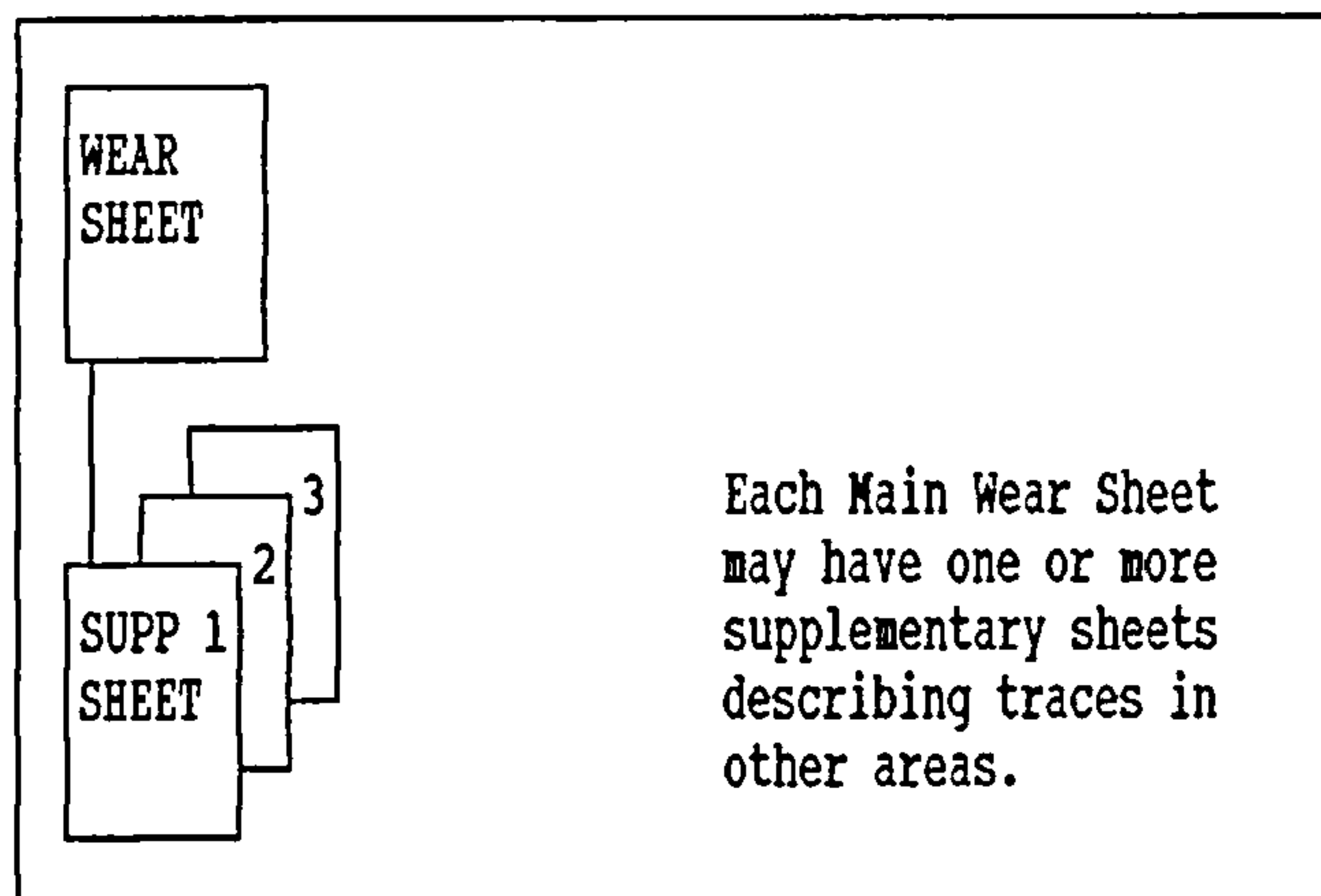


Fig B.5

Recording of Experiments:

A system of recording the use of tools was developed to describe the relevant features of tool and use. The version standardised in the end for the case study work is shown (fig B.4).

The basic system:

A large number of variables were recorded for each piece during the experimental process:

Guide to Experimental Sheet

2: Experiment Sheet

ID: Item Number

Sheet Number

Supp No

Unique

Drawing

Use Number

Worked Material

Category

Sub category

Condition

Extras

Task

Contact Surface

Angle of use

Prehension

Haft

Time Now

Total Time

Effectiveness

Effect On Tool

Start Edge Angle

End Edge Angle

Start Dimensions

End Dimensions

Use Sketch

Photo No

Check

Again, most of the items on this list are self explanatory. *Item number* is the same unique number for every piece, as used on the item sheets. *Sheet number, supplementary number* and *unique* are all part of the internal numbering system. *Drawing* is a sketch of the tool, orientated as for the Item Sheet, to show the area of the tool used, and the area held, covered by a pad or hafted. The rough position of fingers was drawn on. Use number indicates whether this was the first time a tool was used, or whatever.

The worked material box gives details of the material the tool was used on. *Category* is the broad class of material: wood, bone, hide, meat, vegetable, stone, fish, antler. *Sub category* is a simple sub division of these: hard or soft wood, reindeer or red deer antler,

etc. *Condition* refers to the state of the material, dry, wet, seasoned, soaked, fresh. *Extras* refers to the addition of abrasives, grease and so on.

The task box deals with the actual use of the tool. *Task* refers to the general motion used, cut, saw, bore, scrape, shave. *Contact surface* refers to the part of the tool pressing against the worked material, it is described with reference to the drawing orientation of the piece. *Angle of use* refers to the angle between the tool and the worked material (Fig 7.5). *Prehension* refers to the method of prehension, divided here into hand, pad or haft. *Time now* refers to the time the tool has been used during this use, and *total time* refers to the sum of all uses, on this aspect.

Effectiveness covers how well the tool worked at the task, divided into excellent, good, medium, poor and bad, starting well but declining rapidly, etc. *Effect on tool* describes what happened to the tool during use, that was either noticed in performance of the tool (for example performance going down) or that was visible to the naked eye at the end of the task. Examples of the statements are: blunting, negligible, flakes lost, flakes lost then stabilisation and massive attrition. The descriptions for both of the last two categories are subjective descriptions, but they supply important information with regard to the realism of the experiment, and for information on likely number of tools needed for a task, etc. The edge angle was recorded (as above on the item sheet) at both the start and the end of the task, and the same procedure was followed for the dimensions.

At the bottom of the sheet are two boxes. The use sketch box is for an illustration of the task being performed to clarify any problems arising from the description. The Comments box is also provided to clarify any difficulties, and add supplementary information, for example details of hafting.

Recording of Traces

A standard system was developed for the recording of traces. The standard sheet finally adopted is the multiple choice sheet shown in fig B.5. Figs B.6, B.7 and B.9 show the quick guide to these sheets.

Fig B.5: Multiple Choice Trace Sheet

Stone Tool Function WEAR SHEET		Drawing <div>D</div> <div>V</div>					
ID Sheet No of Supp No Unique							
Examination (Use) Dimensions Edge Angle							
Edge Damage Dorsal: P/A Locate Type: Sn/Sc/R (Sn/Sc/R) Scar:D/Md/Mi/Ms/S S/Ms/Mi/Mf/F Size: L/M/S/M <div></div> Freq: R/O/C/F/N/R Pattern: C/S/L		Edge Damage Ventral: P/A Locate Type: Sn/Sc/R (Sn/Sc/R) Scar:D/Md/Mi/Ms/S S/Ms/Mi/Mf/F Size: L/M/S/M <div></div> Freq: R/O/C/F/N/R Pattern: C/S/L		Comments (ED)		MCF01 OK DB PR SUP	
Polish: Locate Pos: E/A/I Area: R/B/P Pattern S/P/L Linear Dir A/P/4/7/Pe/R Sub: P/C/Ra/R Width: B/M/N Length: L/M/S/R Cont: C/S/P Type Texture R/S F/D/I/R/D Link A/P/S Development Dev F/P/M/D/I Bright B/M/Ma Var U/V/WL Edge A/Sh/G/So Features Pits P/A Freq R/O/C/F/N Size L/M/S/Mi Shape Ci/Co/I Lines P/A Freq R/O/C/F/N Dir Pa/45/75/P Width B/M/N/F Con C/S/P Relations		Polish: Locate Pos: E/A/I Area: R/B/P Pattern S/P/L Linear Dir A/P/4/7/Pe/R Sub: P/C/Ra/R Width: B/M/N Length: L/M/S/R Cont: C/S/P Type Texture R/S F/D/I/R/D Link A/P/S Development Dev F/P/M/D/I Bright B/M/Ma Var U/V/WL Edge A/Sh/G/So Features Pits P/A Freq R/O/C/F/N Size L/M/S/Mi Shape Ci/Co/I Lines P/A Freq R/O/C/F/N Dir Pa/45/75/P Width B/M/N/F Con C/S/P Relations		Striations Dorsal Location Dir: P/4/7/Pe Length: L/M/S Depth: D/M/S Width: B/M/N/F Group: P/C/R Reg: C/S Fre: R/O/C/F/N/R Relations		Striations Ventral Location Dir: P/4/7/Pe Length: L/M/S Depth: D/M/S Width: B/M/N/F Group: P/C/R Reg: C/S Fre: R/O/C/F/N/R Relations	
				Comments (Striae)			
				Comments (Polish)			
General Relationships (4)				Comments			

The guide to this sheet is not as simple as the first two guides. At least, while simple, it uses terms that are not as well known, but which are fundamental to the description of traces on a stone item in attributes. Other than the presence/absence descriptions, it is necessary to go through each element in detail.

Edge Damage

Edge Damage
Presence/Absence
Location: Indicate on drawing
Type: Snap/Scar/Rounding
 (if multiple give predominant)
 if Scar: Deep/Most Deep/Mix/Most Shallow
 /Shallow
Size: Large/Medium/Small/Minute
 General Range Box
Frequency: Rare/Occasional/Common/Frequent
 /Numerous/Regular
Pattern: Clustered/Scattered/Layered
Comments: Further details esp direction

Fig B.6: Edge Damage

- 1.1: Location: The presence, and the extent of edge damage has to be located on the drawing of the piece.
- 1.2: Type: Edge damage was divided into three types:
- Snap: equivalent to Keeley’s half-moon breakages, but more commonly now known as snap scars.
 - Scar: a normal flake removal.
 - Rounding: The rounding of an edge, so that no individual scar features could be seen. (Frequently associated with heavy polishing of the edge)

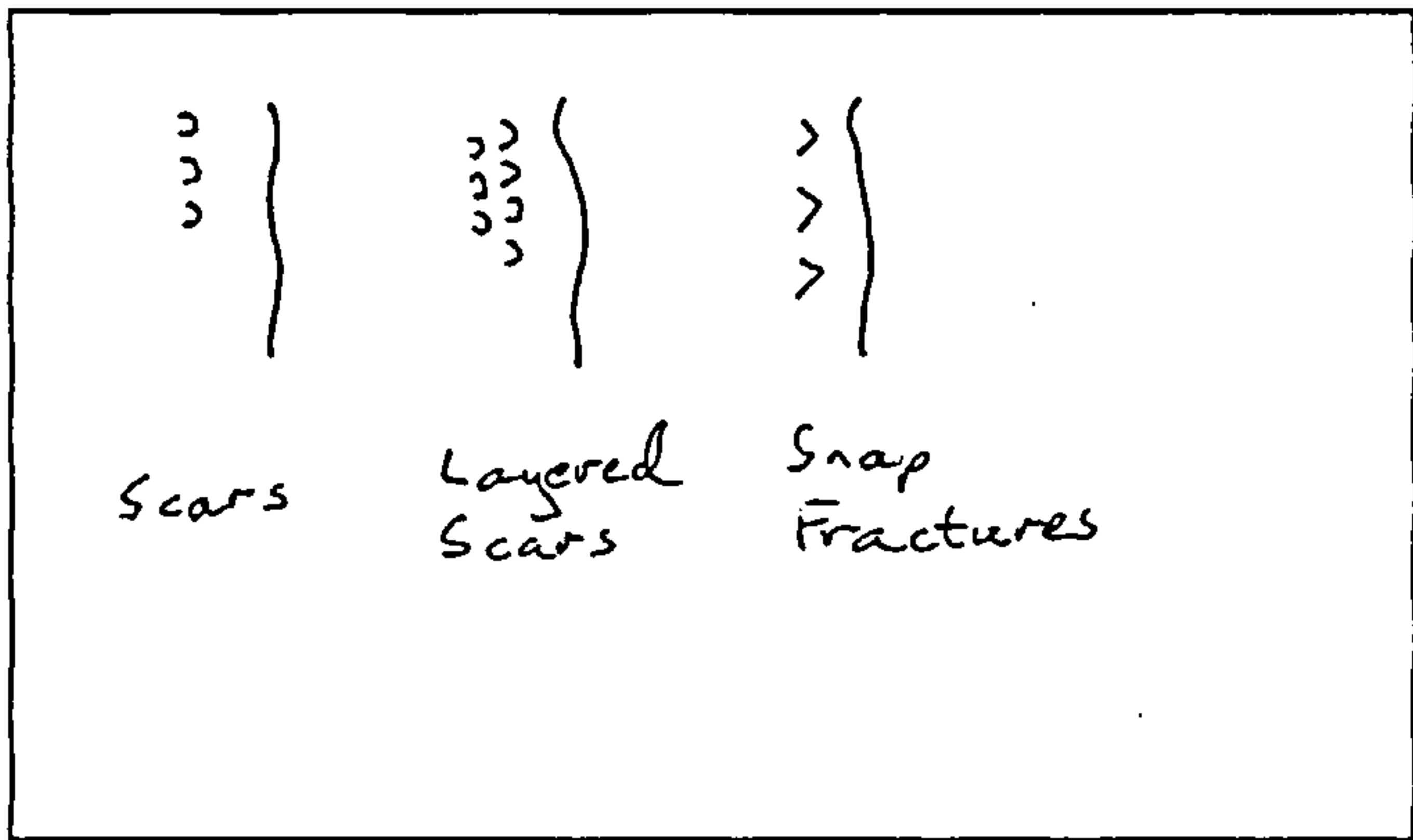


Fig B.7: Edge Damage Location and Type

These scars could occur together, if that was the case then the predominant scar type has to be listed next.

If Scar damage is present, then there are two further subdivisions to be made.

Depth of the scar: Two classes of depth were distinguished, only two to allow quick visual recognition.

Deep scars, when the depth of a scar exceeds its width or length. Depth is taken at the proximal end of the scar.

Shallow scars, when there is no significant depth to the scar, and when both width and length exceed the depth of the scar.

These were described in terms of relative frequency.

Deep: means all (or almost all) were deep scars.

Most Deep: means most are deep, but there are a number of shallow scars.

Mix: means that there are approximately equal numbers of deep and shallow scars.

Most Shallow: means that most are shallow, but that some are deep.

Shallow: means that all, or virtually all, are shallow scars.

The second subdivision of scar damage considered was the termination of the scar. This again was simply divided into step termination and feather termination.

Step: Step termination covers not only typical step terminations, but also includes the various hinge termination variations. No useful further subdivision was found with any finer definition, while checking the precise termination was a very time-consuming task. Step terminations and hinge terminations were not found to be mutually exclusive.

Feather: Typical smooth feather terminations.

These classes are described in terms of frequency, exactly as the scar depths.

1.3: Size: Simple visually discriminated size categories

Large: visible to naked eye

Medium: visible up to 50x

Small: visible up to 100x

Minute: visible up to 200x

1.4: Frequency: Based on the relative frequency of scars, between rare and numerous.

Rare: <5 per screen

Occ: <15 per screen

Common: 15-50 per screen

Frequent: 50-100 per screen

Numerous: >100 per screen

Regular: Continuous

1.5: Pattern: Scars could be either scattered along the edge, or clustered into groups. (Regular is considered clustered). Layered refers to whether or not the scars form a single row along the edge, or whether there are several layers of scars, superimposed on each other (Fig B.7).

1.6: Comments: Any further details of edge damage, in particular: details of orientation; are the scars inclined in any particular direction (this information also goes onto the drawing); and any other individual observations are added here.

Striations

Striations are defined here as scratch marks on the tool surface, on either natural or polished surfaces. As most visible striations are in polishes, recording of striations has tended to be done polish by polish.

Striations
Presence/Absence
Location: Indicate on drawing
Direction: (to working edge)
Parallel/45°/75°/Perpendicular
Length: Long/Medium/Short
Depth: Deep/Medium/Shallow
Width: Broad/Medium/Narrow/Fine
Grouping: (internal)
Parallel/Cross/Random
Regularity: Clustered/Scattered
Frequency: (of groups)
Rare/Occasional/Common/Frequent
/Numerous/Regular
Relationships with other features
Comments: Further detail

Fig B.7: guide to Striations

- 1:Location: Location of striations on the drawing is done in conjunction with the next step.
- 2: Direction: Described in terms of the direction to the working edge. If possible this information should be included on the drawing. (Fig 7.8)
- 3: Length: Relative length, short striae are minimal,barely more than nicks in the surface, long striae have to have considerable length, medium striae are the norm.
- 4: Depth: Relative depth, shallow striae barely penetrate the polish surface, deep striae appear to penetrate through the polish.
- 5: Width: Relative width, fine striae are barely visible at 200x.
- 6: Grouping (internal): the relationship of striae to each other, as opposed to the general trend as in (1)
- 7: Regularity: Are the striae clustered, or scattered over the polish
- 8: Frequency: Relative frequency, from rare, only one or two present to regular, ubiquitous striations.
- 9: Relationships: to other features (edge damage, polish)
- 10: Comments: Any further details, of shape, direction etc.

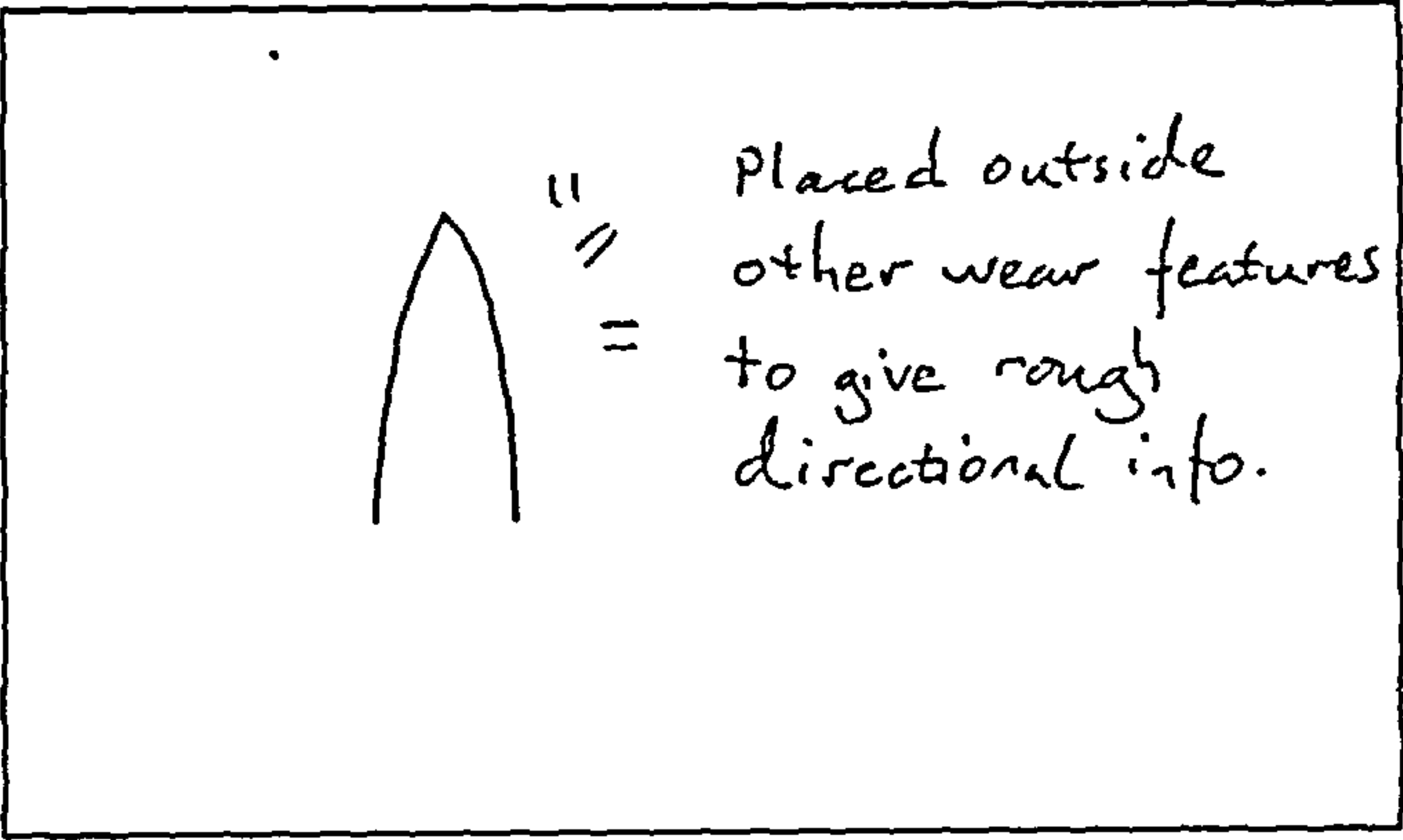


Fig B.8: Striation Indication and Direction

Polish

Polish
Presence/Absence
Location: Indicate on drawing
Position: Edge/Away from edge/Interior Face
Area: Restricted/Broad Spread/Patches
Pattern: Spread/Patchy/Linear
Linear: Direction: Along Edge/Parallel to edge/45o to edge/Perpendicular to edge/Ridges
Sub Pattern: Parallel Lines/Cross lines/Random lines/Ridges
Width: Broad/Medium/Narrow/Ridges
Length: Long/Medium/Short/Ridges
Continuity: Continuous/Semi-Cont /Patchy
Type
Texture: 1) Rough/Smooth
2) Flat/Domed/Invasive/Ret/Dot
Linkage: All over/Partial/Scattered
Development:
Development: Faint/Poor/Medium/Developed/Intense
Brightness: Bright/Medium/Matt
Variability: Uniform/Variable/Widely Variable
Edge: Abrupt/Sharp/Gradual/Soft
Internal Features
Pits: Presence/Absence
Frequency: Rare/Occasional/Common/Frequent /Numerous
Size: Large/Medium/Small/Minute
Shape: Circular/Comet/Irregular
Linearity: (internal) Presence/Absence
Frequency: Rare/Occasional/Common/Frequent /Numerous
Direction: (inside pol) Para/45o/75o/Perp
Width: Broad/Medium/Narrow/Fine
Continuity: Continuous/Semi-Continuous/Patchy
Relationships to other features
Comments: Further details

Fig B.9: Guide to Polish Patterns

Polish: Polish is defined here as an alteration of the natural texture of the surface of the piece. Every distinct polish development pattern is labelled (A,B,C...) and described. The importance of polish attributes is approximately the same as the check list of attributes, with the most important coming first. In the comparison of polishes, this has been the order of comparison.

1: Location: Each polish pattern has to be located as accurately as possible on the sketch drawing.

2: Position: can be a combination, for example edge and away from edge.
 Edge: Extreme edge

Away from Edge: not on extreme edge, but adjacent to the edge
Interior: away from edge

3: Area: treated in combination with pattern.

Restricted: a very limited area of polish

Broad Spread: a large coverage of polish

Patches: while each individual area may be restricted, there is more than one area, and therefore the polish is not limited in extent.

4: Pattern: treated in combination with area

Spread: a general spread of polish, can be restricted in area, broad, or patchy

Patchy: an overall scattered effect, again in combination with area.

Linear: a linear polish, can be restricted, a broad spread, or patchy.

4a: Linear: if the polish is linear, there are a number of additional details:

Direction: all self evident, except perhaps ridges, which is where a polish has developed in a linear fashion along ridges in the material, which follow no particular direction other than those ridges.

Sub-Pattern: if more than one line of polish is present it is necessary to describe the relationship between lines.

Width: Relative width, based upon narrow, very restricted in width, can also be classified by ridges, if the polish width appears to depend upon the width of the ridges it follows, and is therefore variable.

Length: Relative length, ridges is used where length may be variable, depending upon the length of ridges.

Continuity: Continuous linear features have no breaks in them, patchy linear features have frequent breaks.

5: Type: not "wood" etc, but texture and linkage, unlike location, area and pattern above which deal with the distribution of the polish on the macrotopography, type deals with the distribution on the microtopography.

Texture: Smooth and rough refer to the aspect of individual patches of polish. The secondary attributes refer to how the polish has developed on the microtopography. It can be a combination of for example flat/reticulated, where each segment of the polish is flat, but the pattern is broken. Dot refers to an initial appearance of polish, where as only the tips of the microtopography have been effected, the polish appears as scattered dots.

Linkage: refers to the internal pattern of the polish within the area/pattern discussed above. Allover means that there are no breaks within the polish components. Scattered means no linkage between individual polish components.

6: Development:

Development and Brightness: subjective relative measurement of development and brightness. These two attributes do still give a useful guide to the development of the polish.

Variability: a measure of variability within a labelled polish.

Edge: Varies between abrupt, sharp, gradual and soft, where no clear edge to the polish can be perceived.

7: Internal Features:

7a: Pits: Distinct pitting within polish, as opposed to unpolished areas in a scattered polish.

Frequency: relative frequency, rare meaning one or two, numerous meaning ubiquitous over the polish

Size: relative size, minute being barely visible at 200x, large verging on interstitial space between polish. Can include a range of sizes.

Shape: Most common approximate shape.

7b: Linearity: Refers to internal linearity within polish overall area and pattern. Classification is mostly self evident. Direction (within polish) refers to whether the polish is parallel to overall polish development or not. This attribute is useful as most internal linear features occur within overall linear features.

8: Relationships with other features: for example is the polish cut by edge damage, or within edge damage.

9: Comments: Further details, for example on the variability of polish, difficulties in perception caused by material, and development of polish as an edge bevel on the tool edge.

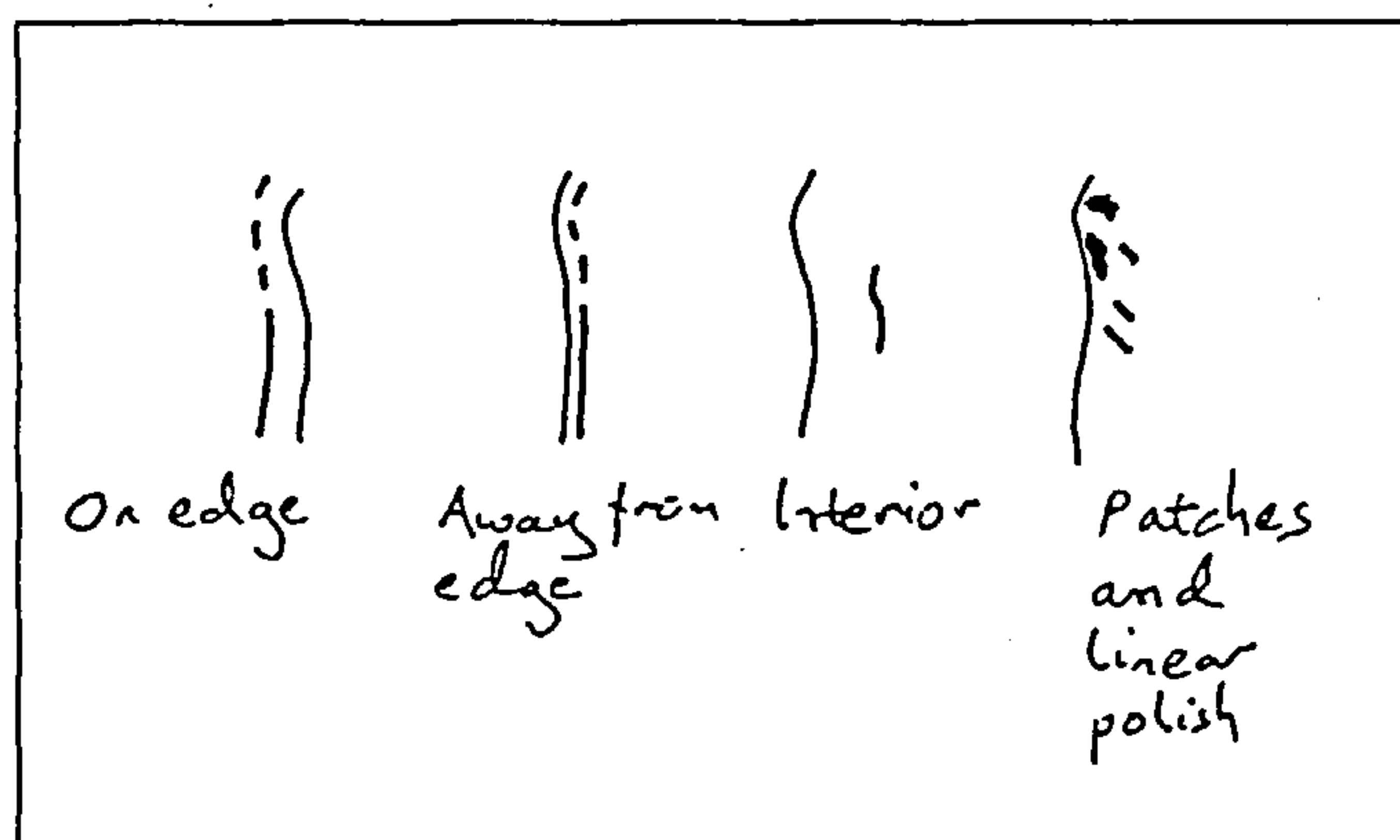


Fig B.10: Polish Location

Equipment Used:

Microscopes

The microscope used throughout the bulk of the project was one that is commonly used for trace analysis, an Olympus BHM metallurgical microscope. Initially, and subsequently for work in the field, a Vickers M12 metallurgical microscope was used. Both of these microscopes were capable of magnifications in the order of 50 to 500x. In addition a Kiowa Zoom Stereoscope, capable of magnifications up to 40x, was also used for preliminary examination of the items. It was found that most of the information gathered from this microscope could be gained simply by using a hand-lens. In addition a Cambridge Scanning Electron microscope was used for very high magnification work (at magnifications of about 1200x) and for the preparation of some images at lower magnifications for the image processing trials.

Microphotography

All of the photographs shown in this work were taken either on the SEM or with an Olympus OM1 camera mounted on the Olympus microscope.

Conclusions

Although the above recording system may appear initially complex and confusing, as a result of the breakdown of polish development patterns into discrete attributes (although many still relative and subjective) and the use of a multiple choice recording system, the recording system is in fact both quick and easy to operate. The wear traces on a tool can be described by a brief set of data, which allows detailed comparative analysis of tools.

Appendix C:

The Case Study Material:

The basic information on the functional analysis of the various sites examined in the text is presented here. Unfortunately there is not room for a detailed piece by piece catalogue, and only the pieces interpreted as used are treated in this fashion. Other material is presented in summary tables.

As there could be a large number of sheets per item on the original record sheets, the information on the used pieces has been reduced to one page for the appendix. Unfortunately in doing so some information has been lost. Also, in an attempt to make the information reasonably accessible, the original format has been changed to brief text descriptions. Only the more significant features are described. The rest of the information is held on archive in the Department of Archaeology, University of Edinburgh, and is available for study. While this arrangement is far from ideal, it is the best compromise currently available.

The illustrations that accompany the descriptions are taken for working edges and are not to scale, but simply represent approximations of shape and proportions.

The sites are presented as follows:

Smittons Appendix C1
Starr Appendix C2
Gleann Mor Appendix C3
Kissonerga Mosphilia Appendix C4
Jebel Naja Appendix C5

Note: The accompanying drawings are diagrammatic representations only and are not to scale

Appendix C1

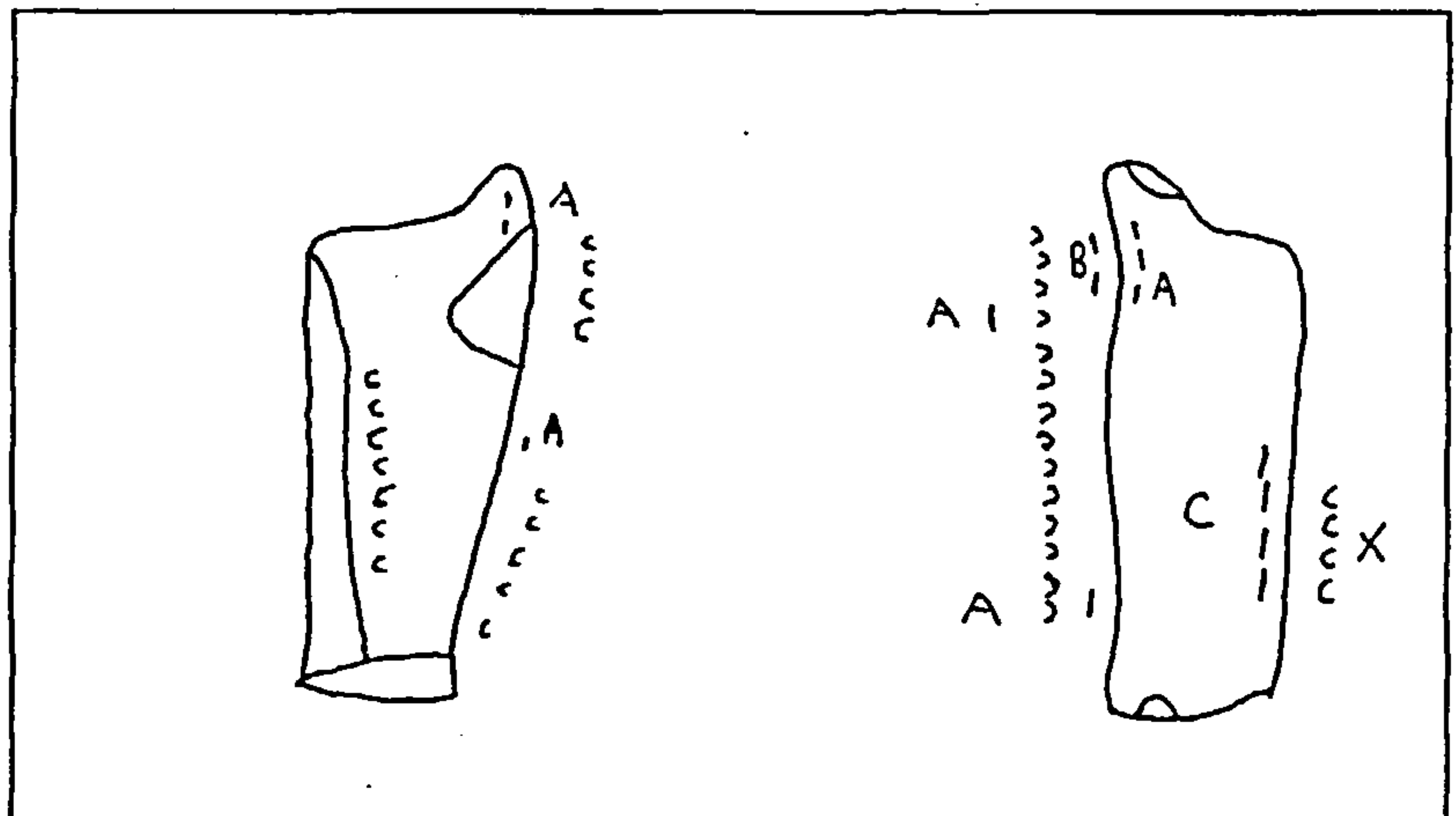
Smittons Basic data

Refer to appendix B for information on recording system

All the pieces interpreted as "used" are described individually, giving a brief textual description of the more significant features to allow quick assessment of these pieces. More detailed information is kept on archive in the Dept of Archaeology, University of Edinburgh.

Following this piece by piece information are various summary tables detailing the complete sample.

Ref: SM003
 Type: ED
 Blank: Blade
 Mat: Chert
 Dim: 46x18x8
 Qual: poor
 Cond: fresh



Material: Grain: M(C),V; Crystals: O; Topography: F; O

Edge angle: Medium

Traces:

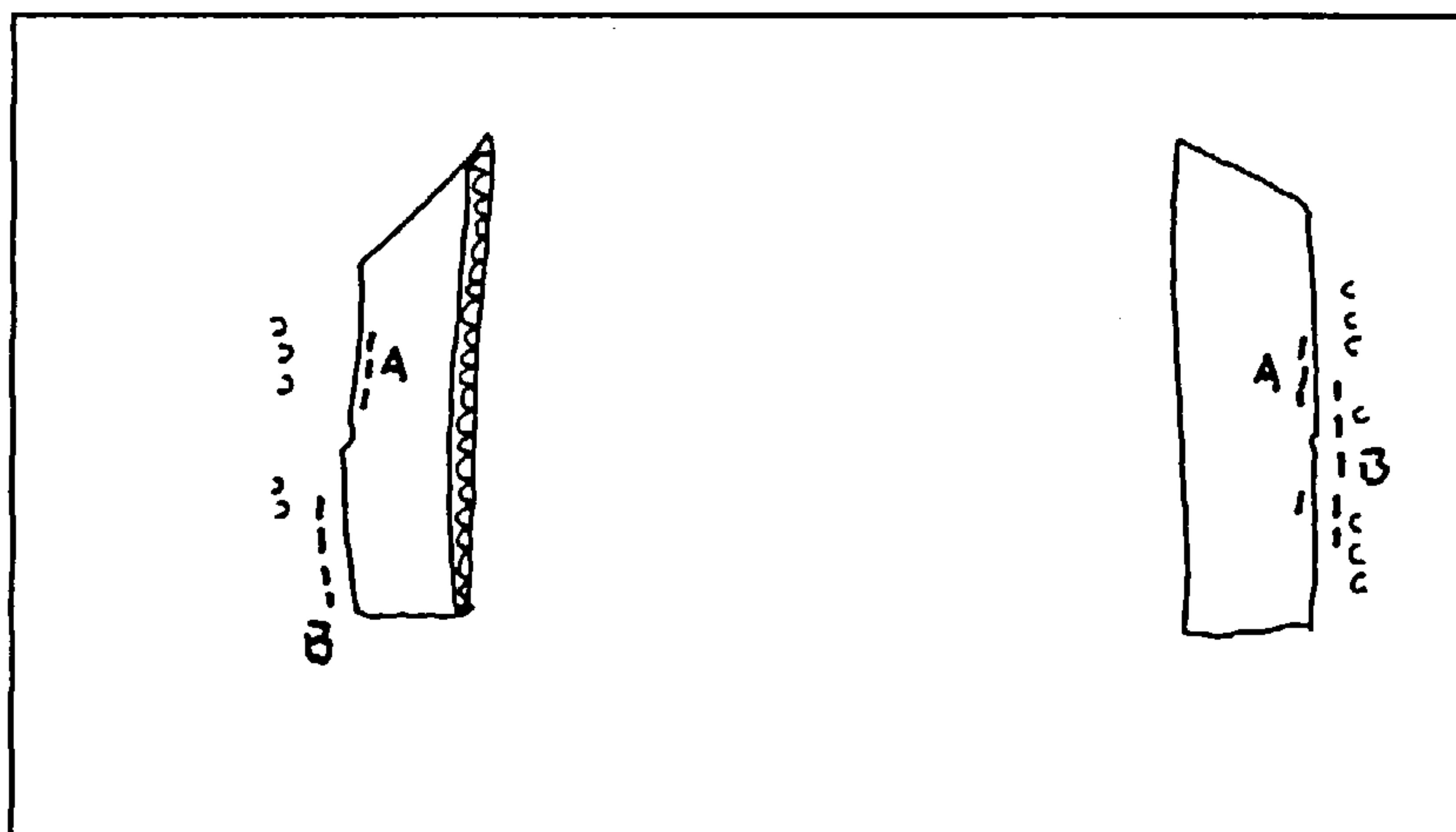
At X: Numerous clustered and layered large to medium step terminating shallow scars, associated with a patchy linear polish feature (C) running as a broad line parallel to the edge. polish is flat, bright, intense, partially linked, with abrupt edges and common internal parallel lines and striations. Interpreted as long motion, very hard material (stone)

On dorsal ridge unassociated scars, interpreted as a techno feature

At a: Frequent clustered large to medium mostly feather terminating deep scars, associated with a patchy spread of variable invasive partially linked polish (A) on the edge, with occasional better developed patches of allover linked polish (B). Interpreted as long motion, minor use

Two separate uses. Traces at X possibly the results of use as a "strike-a-light", very like traces on test piece no 13.

Ref: SM018
Type: MICRO
Blank: BLADE
Mat: FLINT
Dim: 16x5x2
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures: A

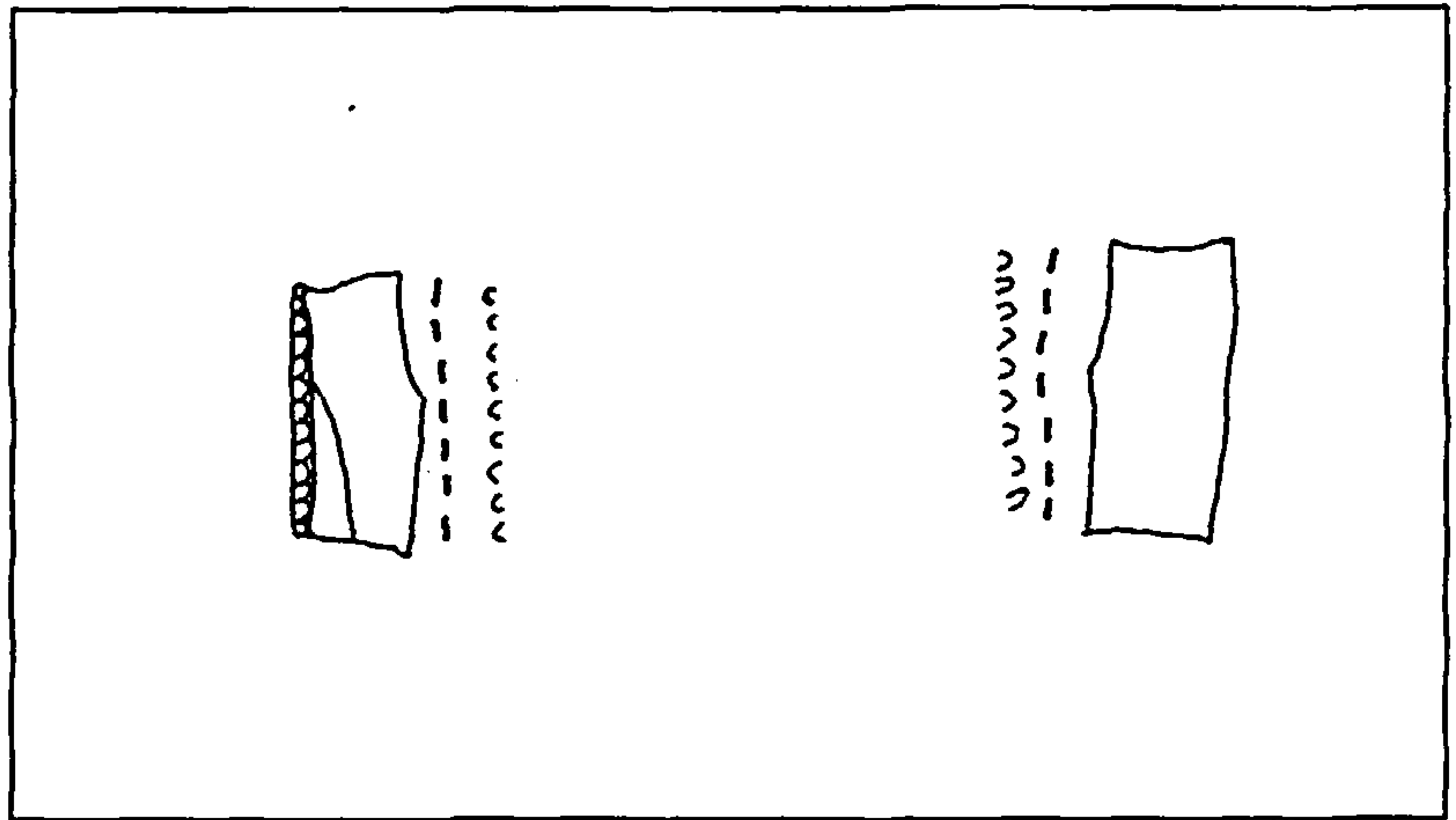
Edge Angle: acute

Traces:

Side a, both faces very similar: occasional to common clustered small mostly step terminating deep scars associated with A: patchy polish away from edge. Polish is smooth reticulated, scattered, with gradual edges and no internal features. Also B: restricted narrow linear polish along edge. Polish is smooth invasive, partially linked, poor, with gradual edges, and no internal features. Forms a bevel

Interpretation: side a used
Comments:

Ref: SM022
Type: MICRO
Blank: BLADE
Mat: FLINT
Dim: 11x5x2
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures: A

Edge Angle: acute

Traces:

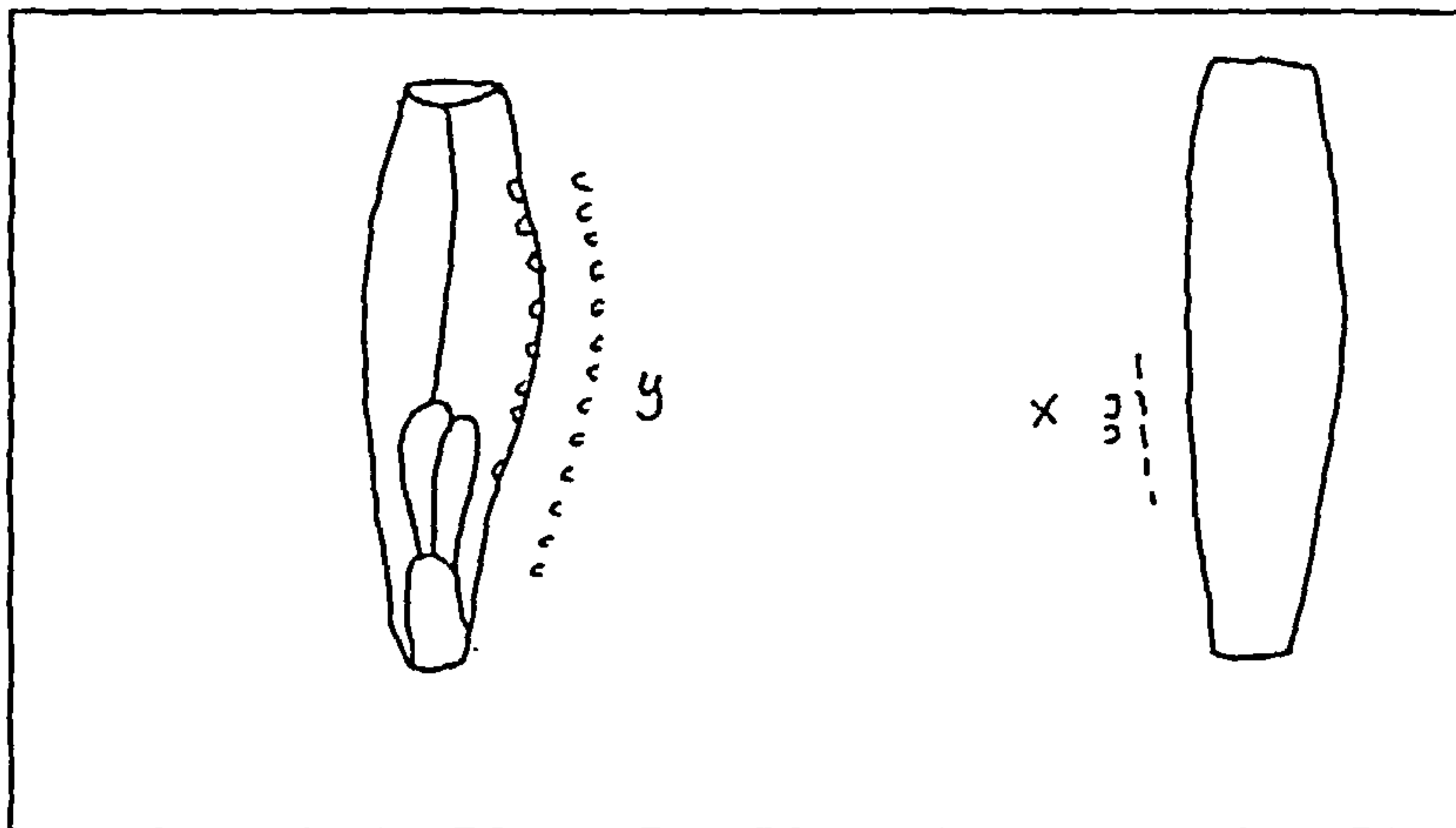
Dorsal side b: common scattered minute mostly step terminating deep scars with snaps associated with a restricted narrow linear polish along the edge. Polish is smooth domed and invasive, partially linked, with gradual edges and no internal features.

Ventral side b: common scattered medium to minute mostly step terminating deep scars associated with a restricted narrow linear polish along the edge. Polish is smooth invasive, partially linked, poor, with gradual edges and no internal features.

Interpretation: side b used. Opp use?

Comments:

Ref: SM026
Type: ED
Blank: B
Mat: Flint
Dim: 37x13x4
Qual: Exc
Cond: Fresh



Material: Grain: F, H; Crystals: O; Topography: F; A

Edge Angle: acute

Traces:

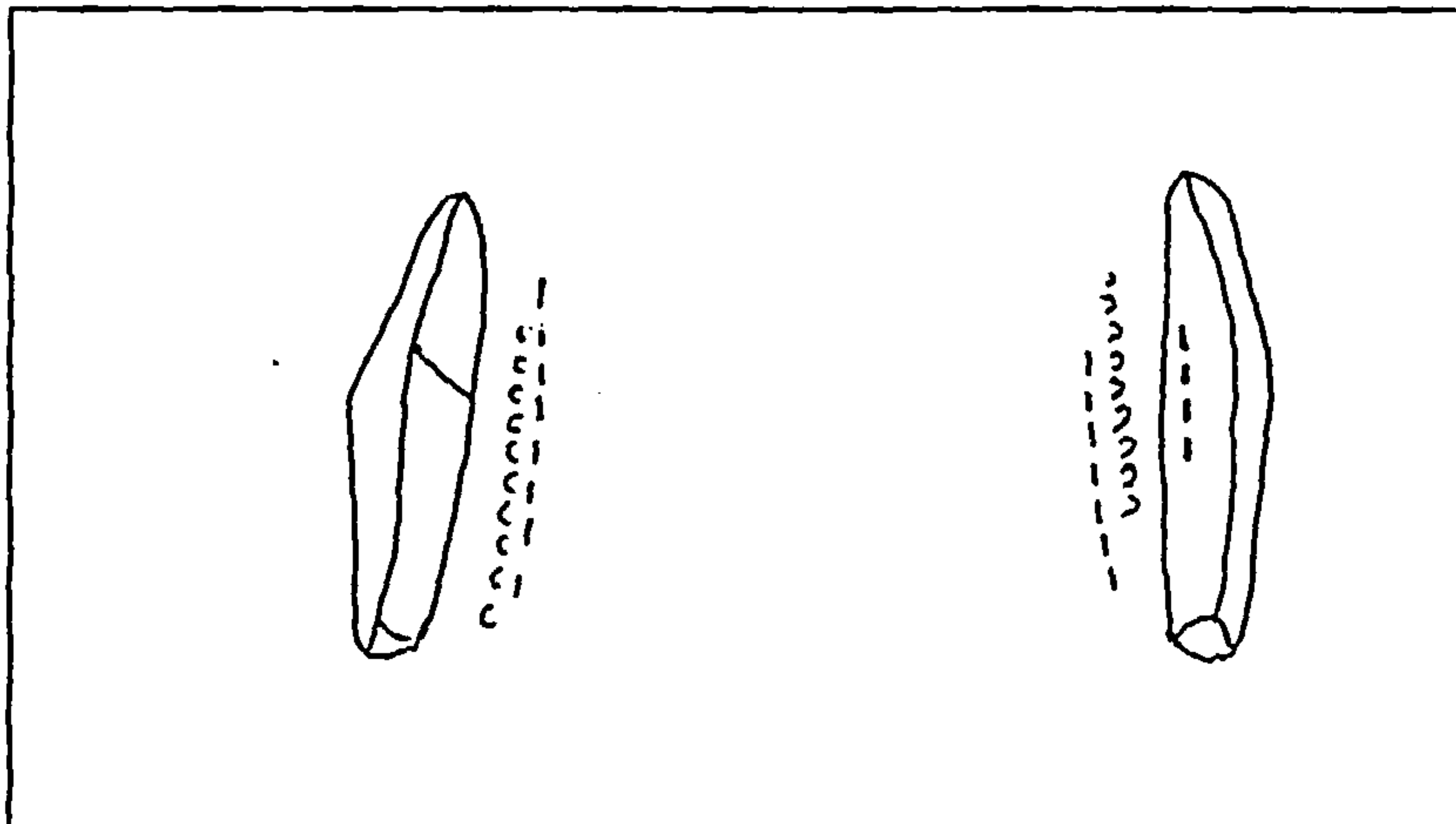
At X: Occasional clustered medium mostly feather terminating mostly deep scars, associated with a restricted semi-continuous linear polish running along edge. Polish is smooth, invasive and partially domed, developed, all over, with fairly sharp edges and common small circular pits.

At Y: Frequent clustered small mixed termination mostly shallow scars and occasional snaps.

Occasional other small patches of polish on dorsal interior face.

Interpretation: Used, unifacial, ventral lead, soft mat
Comments: Intense work to produce pol A

Ref: SM038
Type:
Blank: Blade
Mat: Flint
Dim: 19x6x2
Qual: Exc
Cond: Fresh



Material: Grain: F Homog: V Crys: A Topo: F Fissures:
A

Edge Angle: acute

Traces:

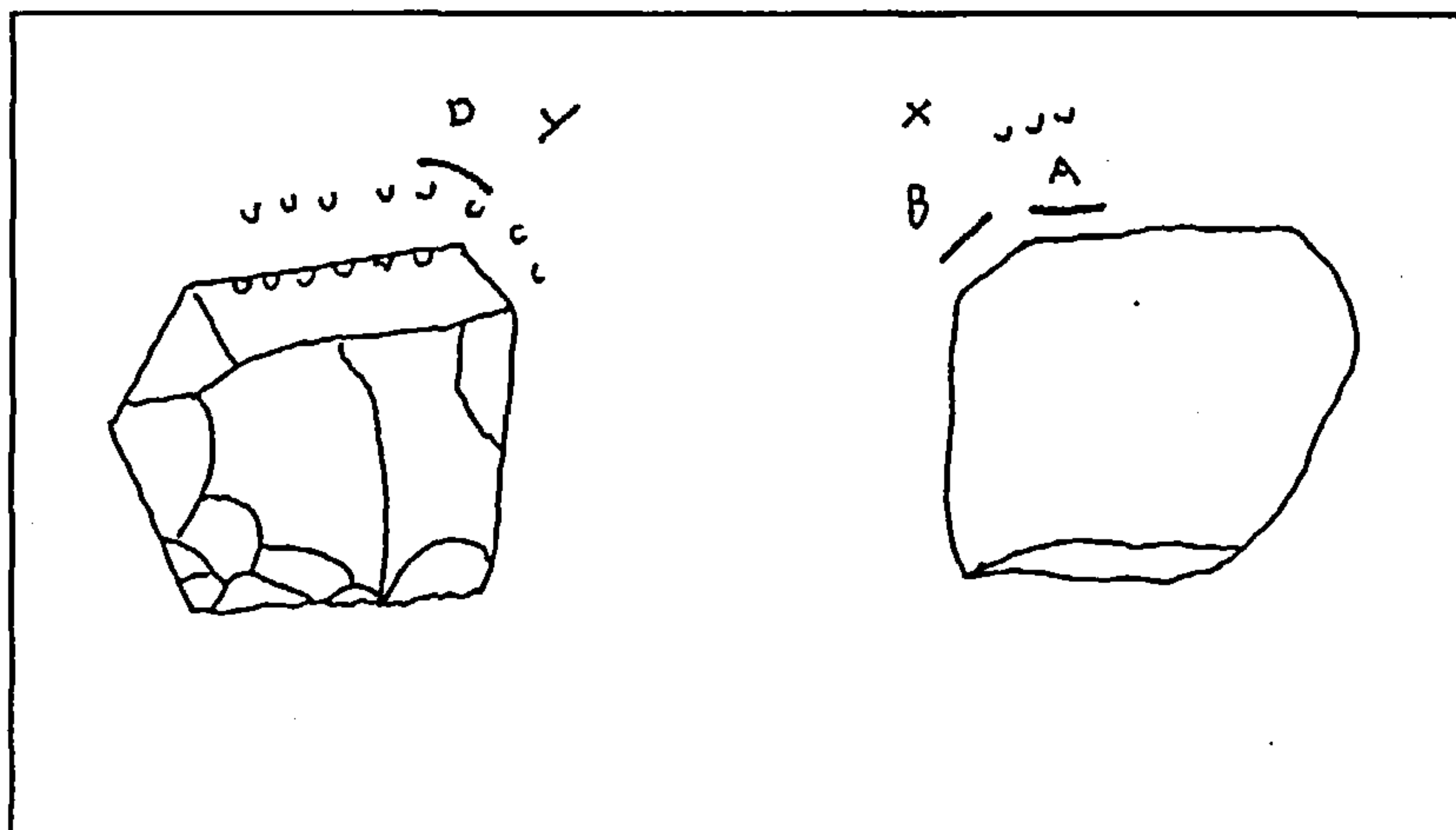
Side B: Dorsal and Ventral virtually identical:
Common to frequent clustered and layered small
mostly feathered deep scars, associated with a
patchy linear polish along the edge. Polish is
smooth, domed, medium, partially linked, with
gradual edges and no internal features.

On Ventral parallel to side B: Patchy linear polish,
flat, partially linked, medium, with sharp edges and
occasional small irregular pits. Associated with a
bright streak.

Interpretation: Pos techno, but no obvious cause. Long
motion, probably used.

Comments: Quite like strike-a-light

Ref: SM056
Type: ED
Blank: Flake
Mat: Flint
Dim: 25x34x8
Qual: Good
Cond: Patina



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A

Edge Angle: acute

Traces:

At X: Occasional clustered medium mostly step terminating deep scars, associated with A: restricted narrow linear polish along edge. Polish is domed, partially linked, medium, bright, variable with sharp edges and occasional minute circular scars. Also B: Patchy linear polish along edge. Polish is flat (invasive), allover, developed, bright, with sharp edges and rare small irregular pits.

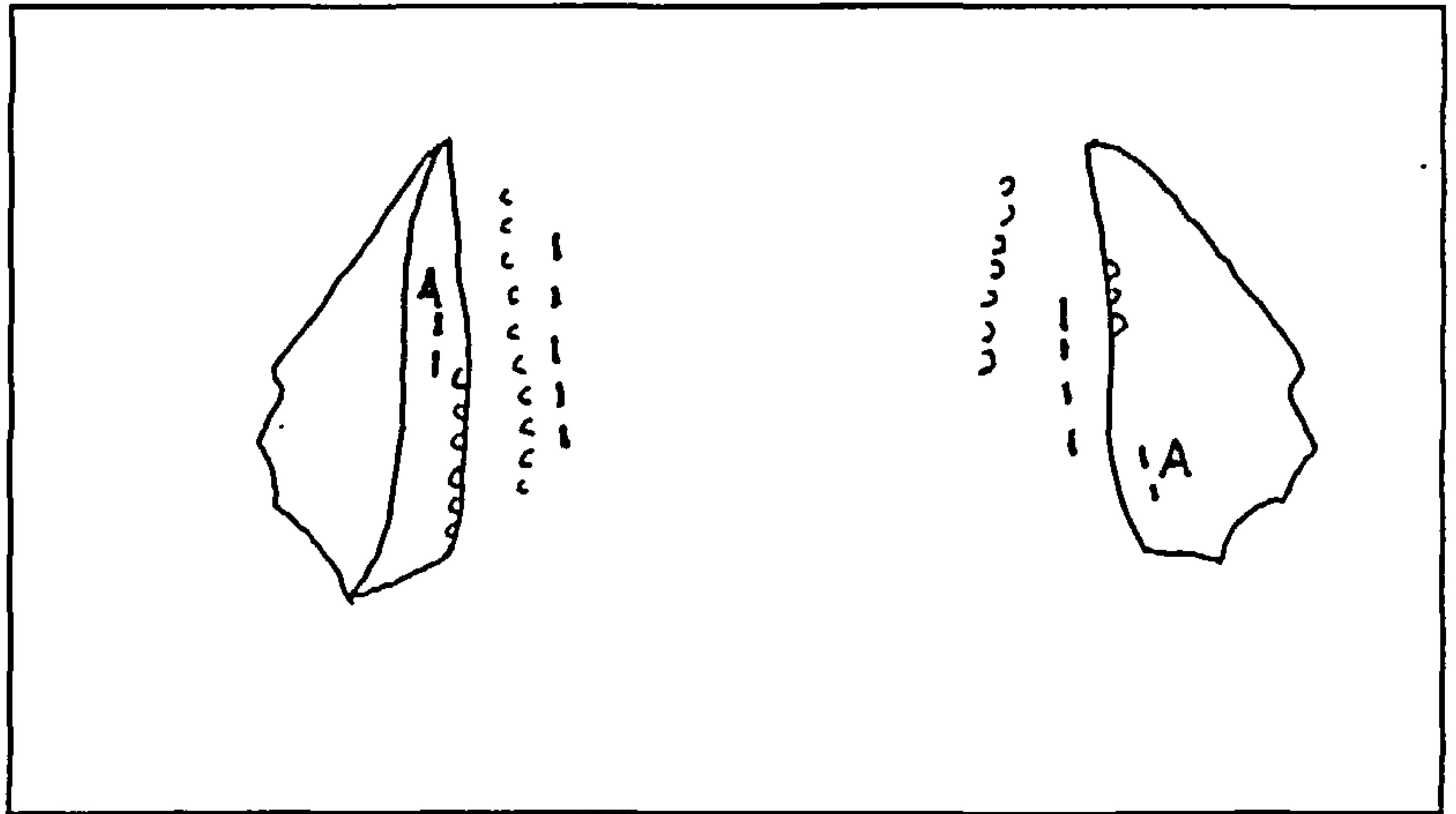
At Y: Frequent clustered and layered large to medium mostly step terminating mostly deep scars, associated with (D) broad spread of polish along edge. Polish is domed reticulated, partially linked, medium developed with soft edges and common variable irregular scars.

On side b, scattered edge damage and patches of polish.

Interpretation: Probably long motion, using corner of distal and side b in particular

Comments: Cross section causes variation in polish distribution between ventral and dorsal

Ref: SM057
Type: ED
Blank: FLAKE
Mat: CHERT
Dim: 25x34x8
Qual: GOOD
Cond: FRESH



Material: Grain: M Homog: H Crys: C Topo: F Fissures:
A

Edge Angle: medium

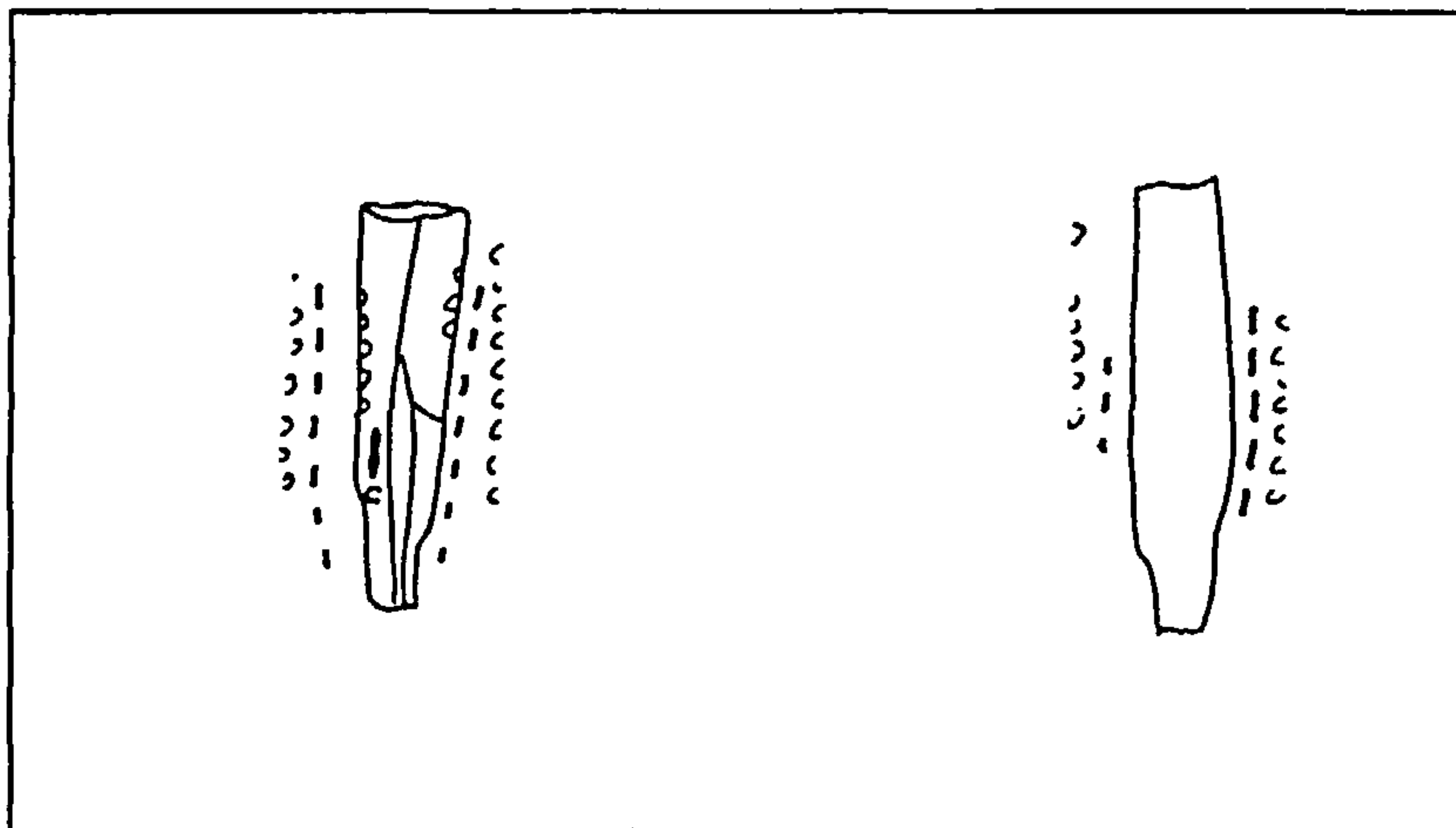
Traces:

Side B: Dorsal and Ventral virtually identical:
Clustered occasional to frequent medium to small
mostly feather terminating mostly deep scars
associated with A: Patchy polish on edge on ventral
and away from edge on dorsal and ventral. Polish is
smooth domed, allover, intense, bright, abrupt edges
with occasional medium circular pits. Also B: Patchy
polish along edge. Polish is domed reticulated,
partially linked, medium with soft edges and no
internal features. Side b has marked edge bevel.

Occ patches of polish on dorsal

Interpretation: Side B used, long motion, pos soft
material, shallow penetration, long use.
Comments: Crystals cause some problems

Ref: SM058
Type: ED
Blank: BLADE
Mat: CHERT
Dim: 26x9x4
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
O

Edge Angle: thick

Traces:

Dorsal, sides a and b, both edge damage and polish concentrated on side a: common clustered small mostly feather terminating deep scars associated with a patchy spread of polish along edge. Polish is smooth domed partially linked, developed, with soft edges and occasional small irregular pits.

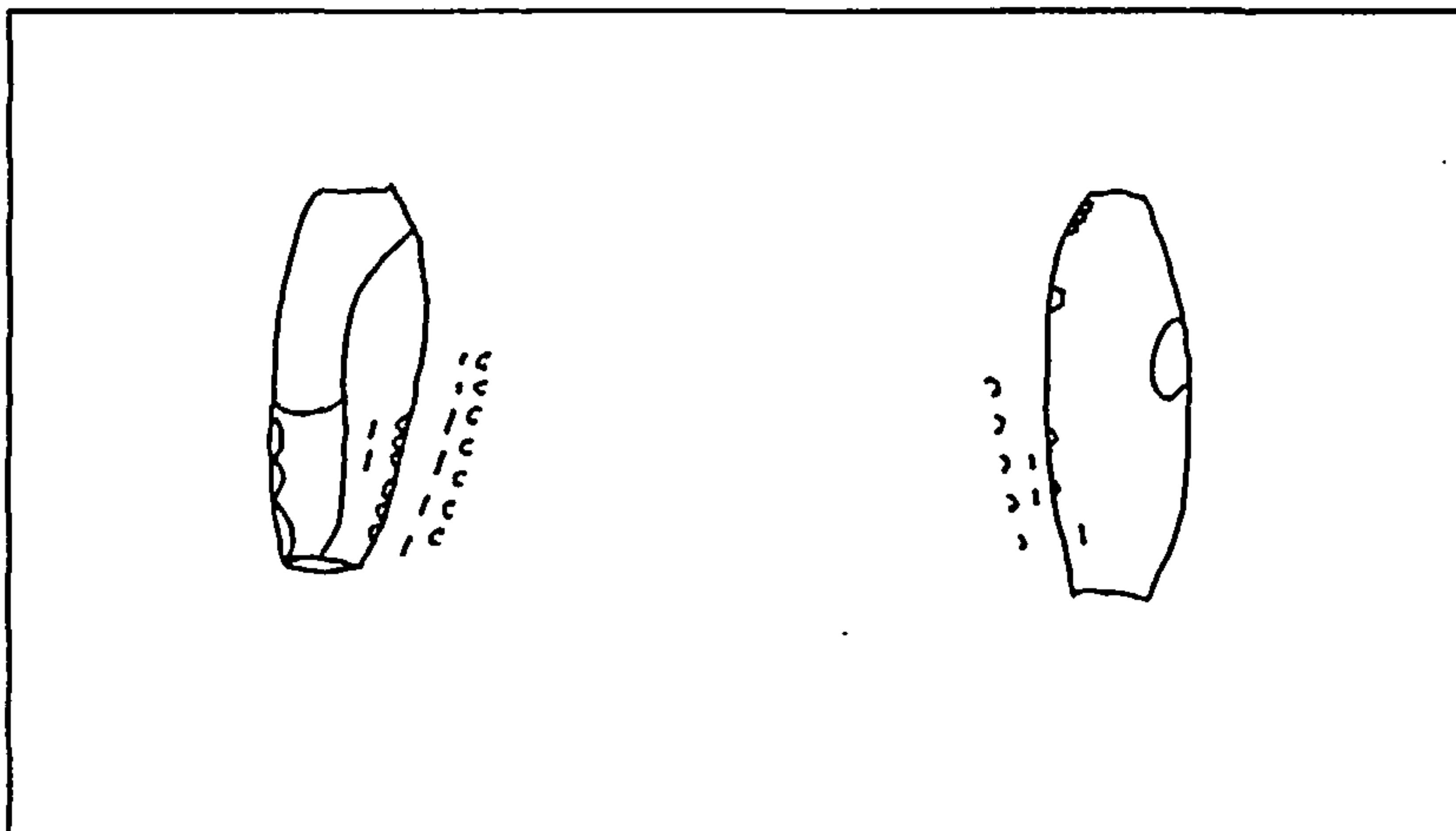
Dorsal: C: away from edge but parallel to edge linear polish. Smooth domed, allover, bright, developed, gradual edge with occasional small irregular pits.

Ventral, sides a and b, both edge damage and polish concentrated on side a: numerous clustered medium mostly step terminating deep scars associated with a patchy spread of polish along edge. Polish is reticulated with soft edges and no internal features.

Interpretation: Used, side a especially, possibly long motion

Comments: Difficult

Ref: SM059
Type: ED
Blank: BLADE
Mat: CHERT
Dim: 19x9x3
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
O

Edge Angle: medium

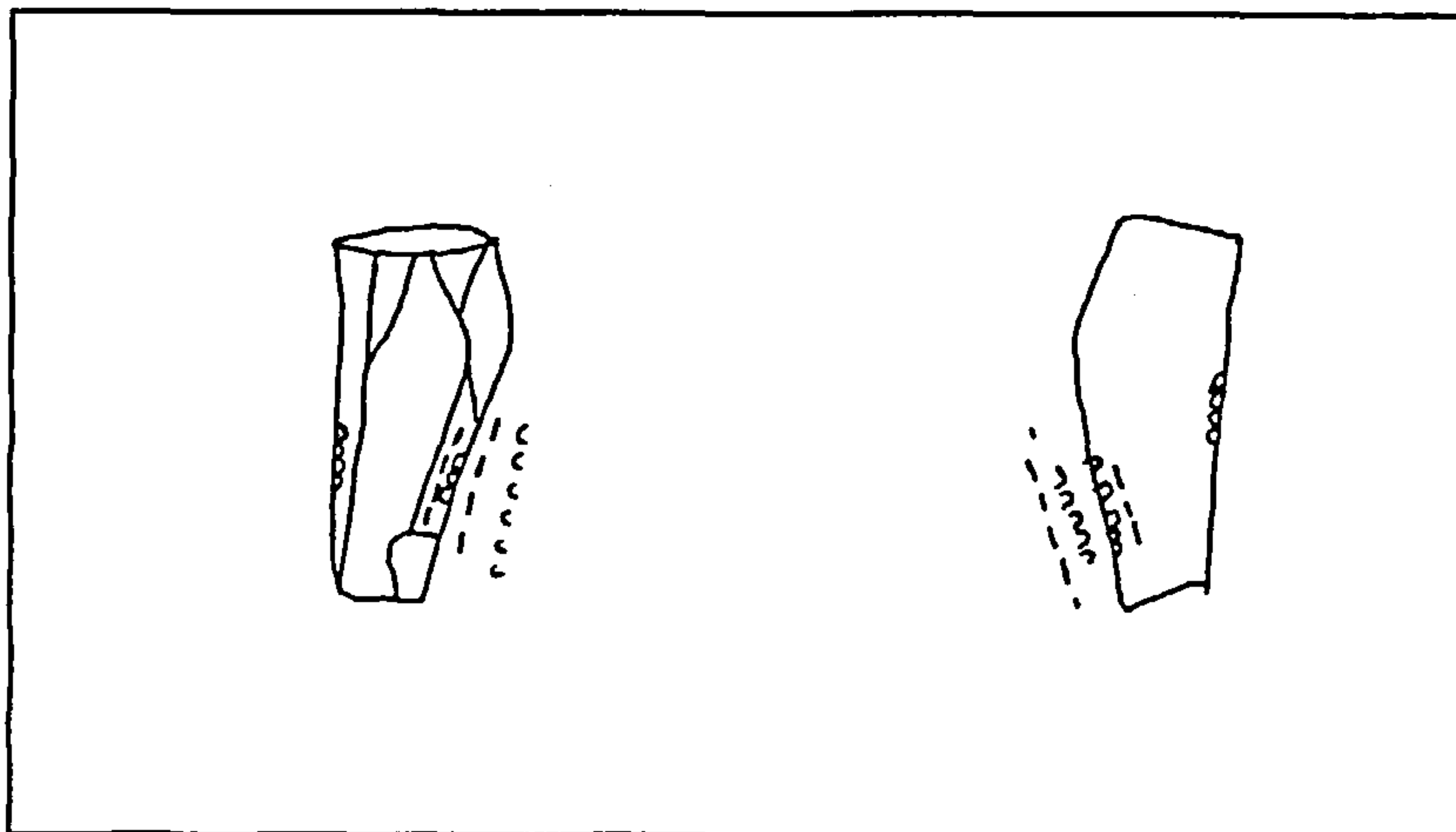
Traces:

Side B: nearly all on dorsal, occasional scars/polish patches on ventral: Common clustered medium to small mostly feather terminating deep scars associated with patchy polish along and away from edge. Polish is smooth domed and invasive, partially linked, variable with soft edges and occasional small circular pits. Only on dorsal also polish B: patchy polish away from edge. Polish is smooth domed, partially linked, developed, bright with sharp edges and no internal features.

Interpretation: Used

Comments: Problem in that features are concentrated on a single face and edge damage and polish are concentrated on the same face

Ref: SM060
Type: ED
Blank: BLADE
Mat: CHERT
Dim: 24x11x5
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A

Edge Angle: medium

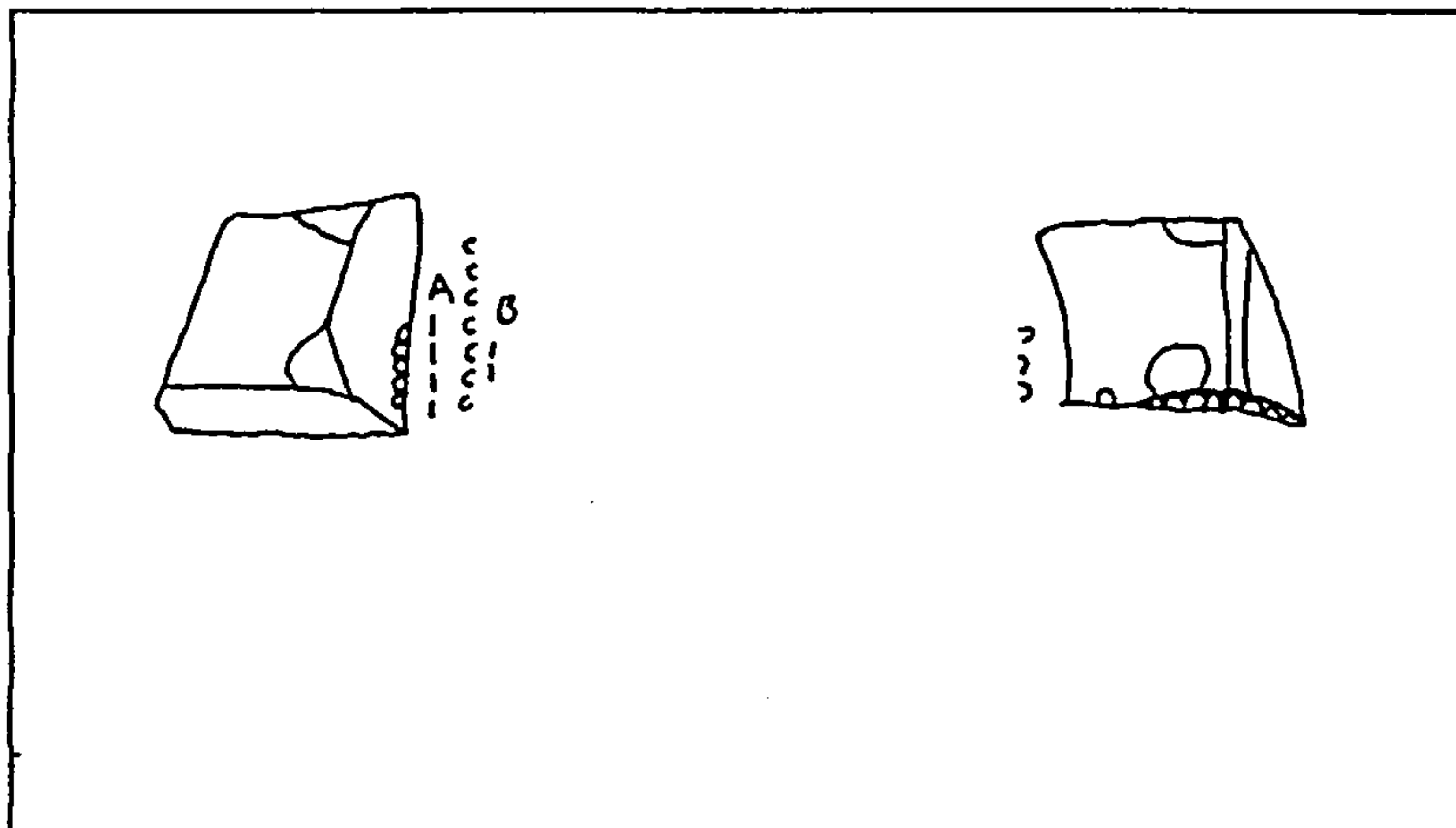
Traces:

Side b, virtually identical on both faces: Common clustered large to small mostly step terminating mostly deep scars associated with A: restricted narrow linear polish along edge. Polish is smooth domed allover intense, bright, with abrupt edge and occasional small irregular pits, forms edge bevel; and B: patchy polish away from edge. Polish is smooth domed partially linked, medium, with gradual edge and occasional medium irregular pits.

Interpretation: Used, bifacial , long motion, hard material

Comments:

Ref: SM075
Type: RETOUCH
Blank: FLAKE
Mat: CHERT
Dim: 14x10x7
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures: C

Edge Angle: thick

Traces:

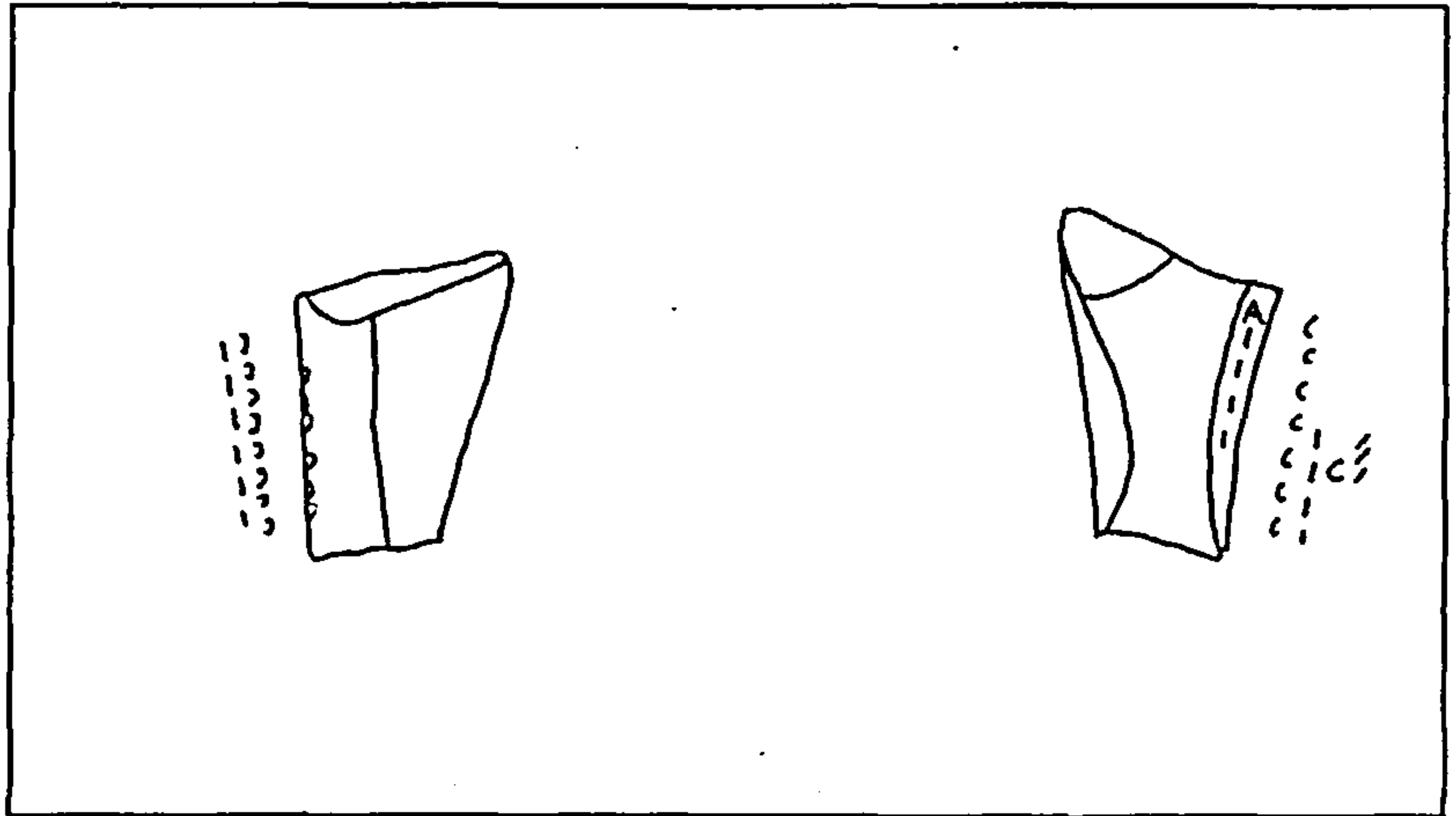
Dorsal, side b: common clustered and layered medium to small mostly step terminating deep scars with rounding, associated with A: broad patchy polish on edge. Polish is domed invasive partially linked, medium and variable with gradual edges and no internal features; and B: restricted patchy polish on edge. Polish is smooth domed, all over, developed, with gradual edges and no internal features.

Ventral, side b: Common clustered small mostly feather terminating deep scars with rounding

Interpretation: used, unifacial polish and rounding suggest transverse motion

Comments: NB, retouch unused, B just better developed version of A on raised parts of microtopography

Ref: SM076
Type: ED
Blank: FLAKE
Mat: CHERT
Dim: 16x13x5
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: V Crys: O Topo: R Fissures:
C

Edge Angle: thick

Traces:

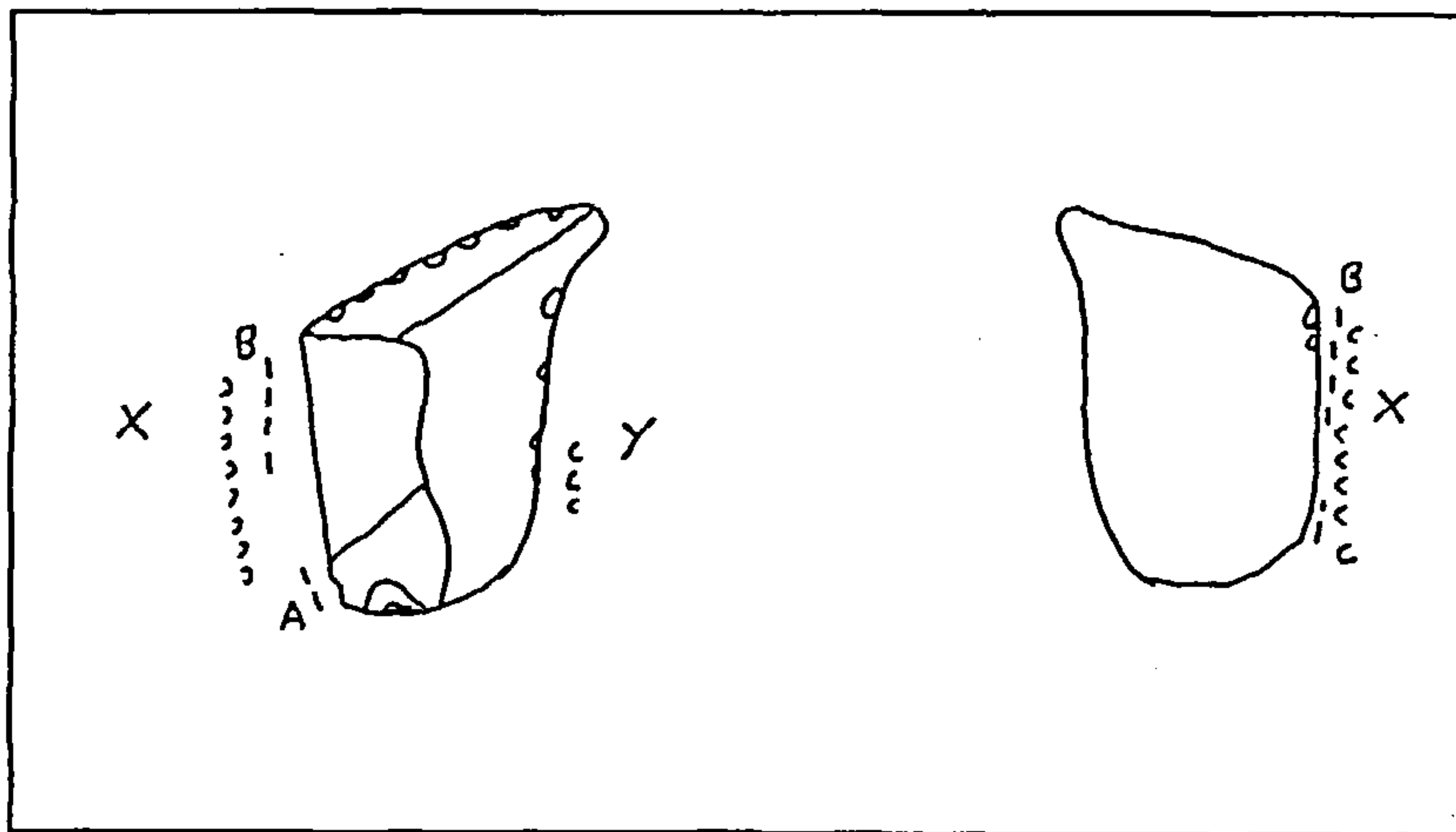
Dorsal, side a: common clustered small mostly feather terminating deep scars associated with broad spread of polish on and away from edge. Polish is smooth domed (reticulated) partially linked, with soft edges and no internal features

Ventral, side a: Occasional clustered minute mostly feather terminating deep scars associated with A: patchy polish along the edge, away from the edge and interior. polish is smooth flat allover, intense, bright, with abrupt edges and occasional medium circular pits. In polish are long deep broad striations clustered at 45° to the edge. Also with C: restricted narrow linear polish along edge. Polish is smooth domed, with sharp edges and no internal features.

Interpretation: Used, differential development suggests transverse use. Probably soft mat

Comments: striae suggest harder mat - or inclusions

Ref: SM078
Type: ED
Blank: FLAKE
Mat: CHERT
Dim: 24x19x4
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
O

Edge Angle: acute

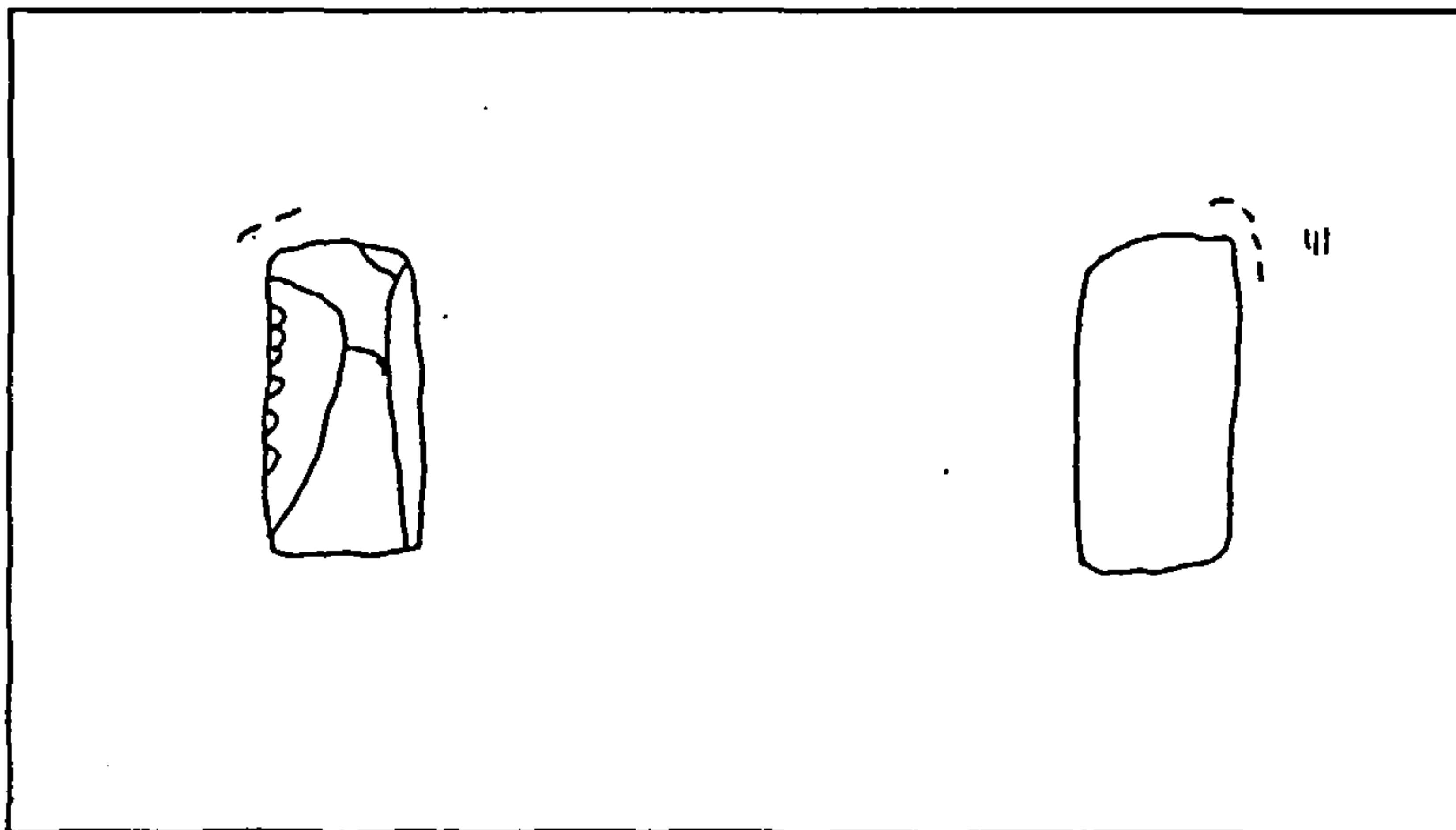
Traces:

At X, both dorsal and ventral: Common clustered medium to small mostly feather terminating mostly deep scars associated with A (on dorsal): restricted patch away from edge. Polish is smooth domed, allover, developed with sharp edges and occasional minute irregular pits; B: patchy spread of polish along edge. Polish is smooth reticulated scattered poor, variable with soft edges and no internal features; C: restricted polish patches on edge. Polish is flat reticulated, developed, bright, with abrupt edges and occasional minute irregular pits.

At Y: common clustered medium to small step terminating deep scars.

Interpretation: side a used. Side b = prehension/hafting?
Bifacial traces = longitudinal motion
Comments:

Ref: SM081
Type: ED
Blank: FLAKE
Mat: CHERT
Dim: 17x9x4
Qual: MED
Cond: FRESH



Material: Grain: F Homog: V Crys: C Topo: R Fissures:
0

Edge Angle: thick

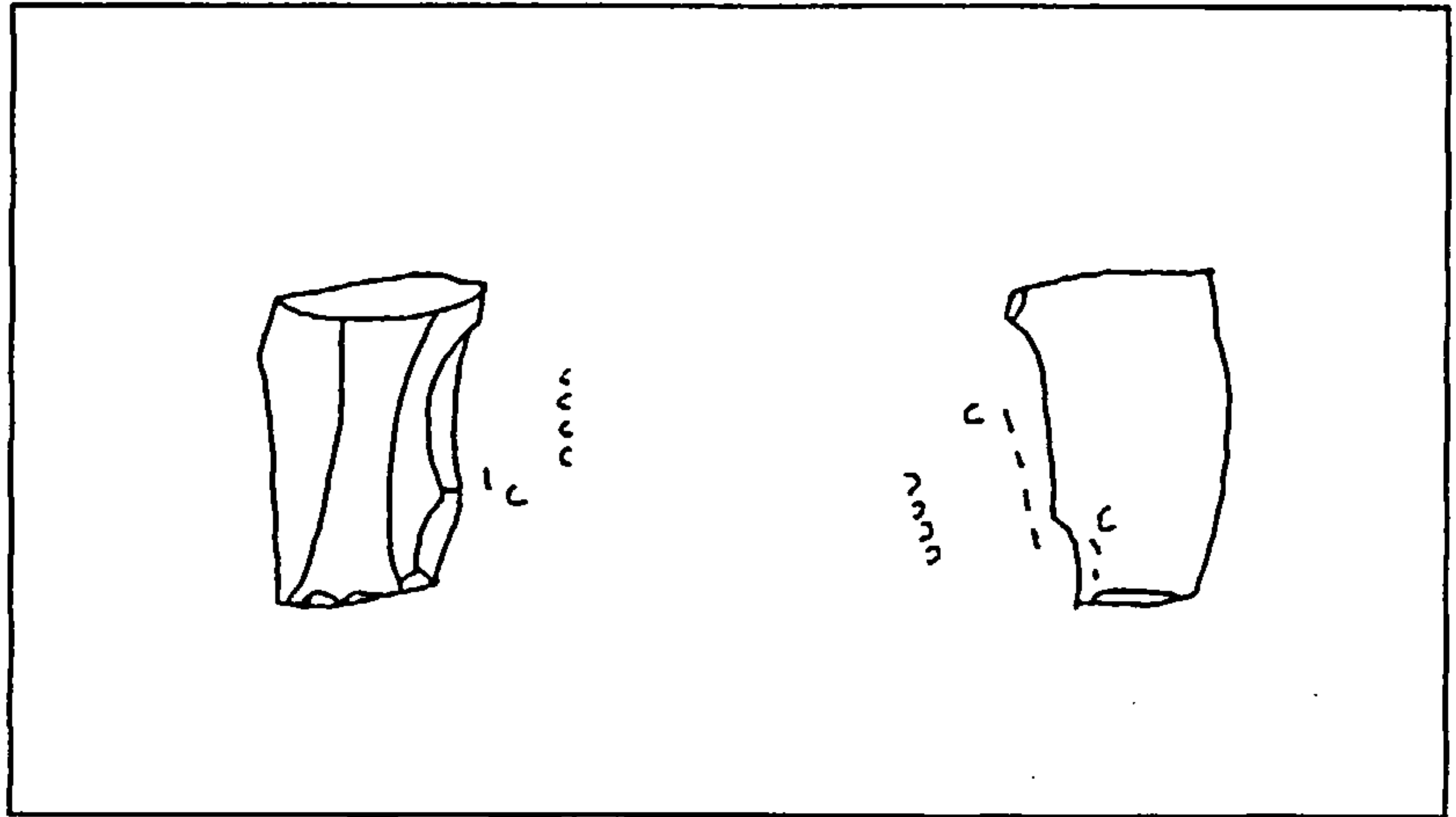
Traces:

Dorsal: Away from edge restricted narrow linear polish. Polish is smooth domed, allover, developed, with gradual edges and frequent small circular pits.

Ventral: Patchy narrow linear polish along edge. Polish is smooth, invasive, partially linked, with gradual edges and common variable irregular pits. Associated are rare parallel short, shallow, fine clustered striations.

Interpretation: Extreme corner used, bifacial = longitudinal motion, away from edge linear = groove
Comments: Soft material as no edge damage, but thickness of edge stable = med soft to med hard

Ref: SM088
Type: ED
Blank: FLAKE
Mat: CHERT
Dim: 22x18x5
Qual: GOOD
Cond: FRESH



Material: Grain: M Homog: V Crys: O Topo: F Fissures:
O

Edge Angle: thick

Traces:

Dorsal side b: common clustered and layered medium mixed termination mostly deep scars associated with occasional v small and restricted patches of polish C.

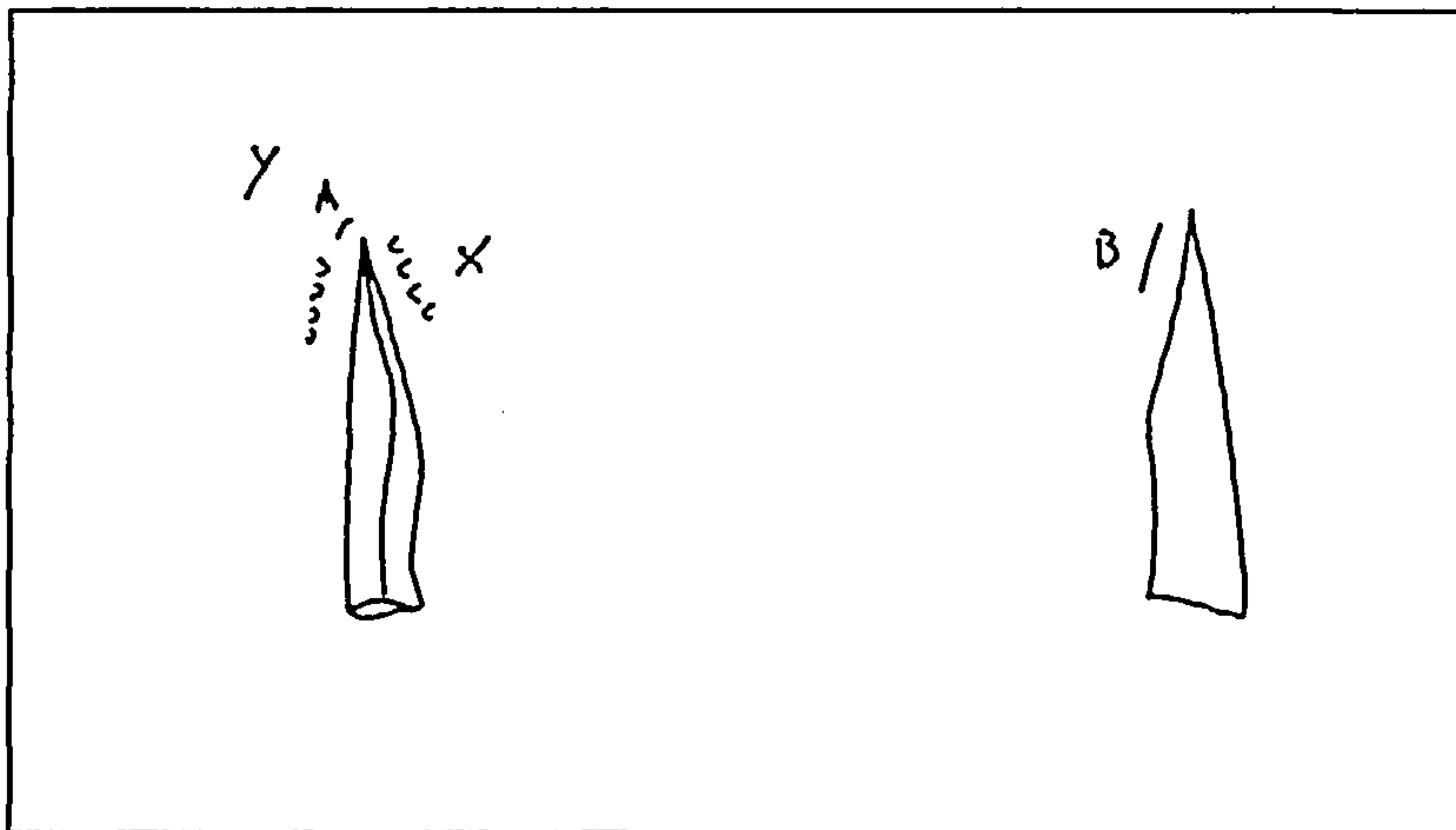
Ventral side b: common clustered and layered small mostly feather terminating mostly deep scars associated with C: restricted patches of polish along and away from edge. Polish is flat (domed and reticulated) partially linked, developed, bright, with sharp edges and common medium circular pits

Also scattered edge damage around rest of edges, and general weak spread of polish, concentrated on ventral side a, and a linear polish on ventral distal.

Interpretation: side b used, transverse motion

Comments: remainder of traces possibly prehension/hafting

Ref: SM091
Type: ED
Blank: BLADE
Mat: CHERT
Dim: 15x5x3
Qual: GOOD
Cond: FRESH



Material: Grain: M Homog: V Crys: C Topo: F Fissures:
O

Edge Angle: point

Traces:

At X: occasional clustered medium step terminating deep scars.

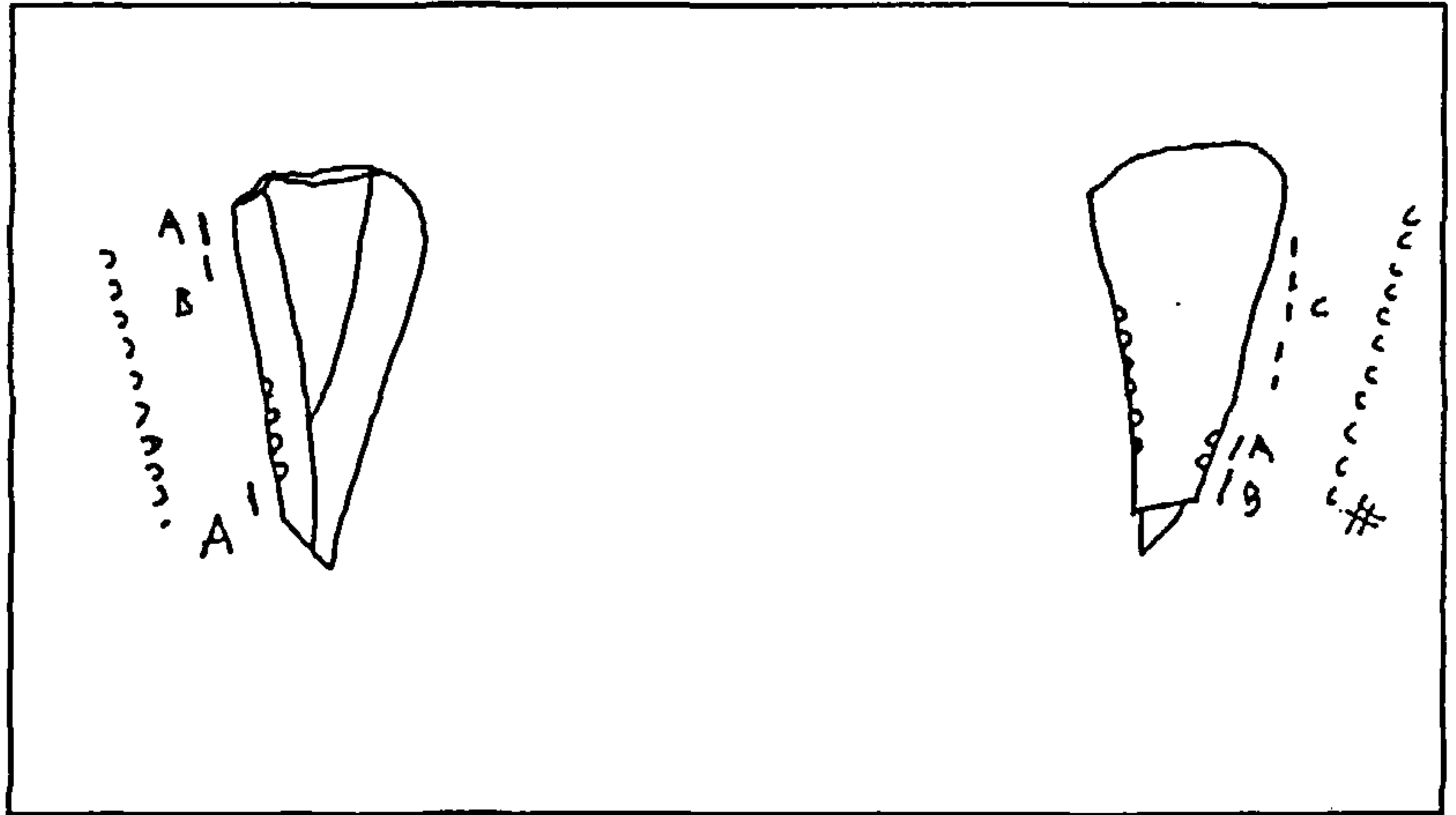
At Y: common clustered medium mostly feather terminating deep scars associated with A: patchy polish away from edge. Polish is smooth reticulated, scattered, poor, variable with gradual edges and no internal features. Edge damage goes right up to tip without destroying point. A concentrated at extreme tip.

Ventral: Polish B restricted narrow linear along edge. polish is smooth domed allover, developed, with abrupt edges and no internal features B forms an edge bevel.

Interpretation: Used as point, anti-clockwise?

Comments: work has to be very gentle/soft material as tip is still intact

Ref: SM092
Type: ED
Blank: BLADE
Mat: CHERT
Dim: 27x12x7
Qual: POOR
Cond: SW



Material: Grain: M Homog: V Crys: C Topo: F Fissures: C

Edge Angle: thick

Traces:

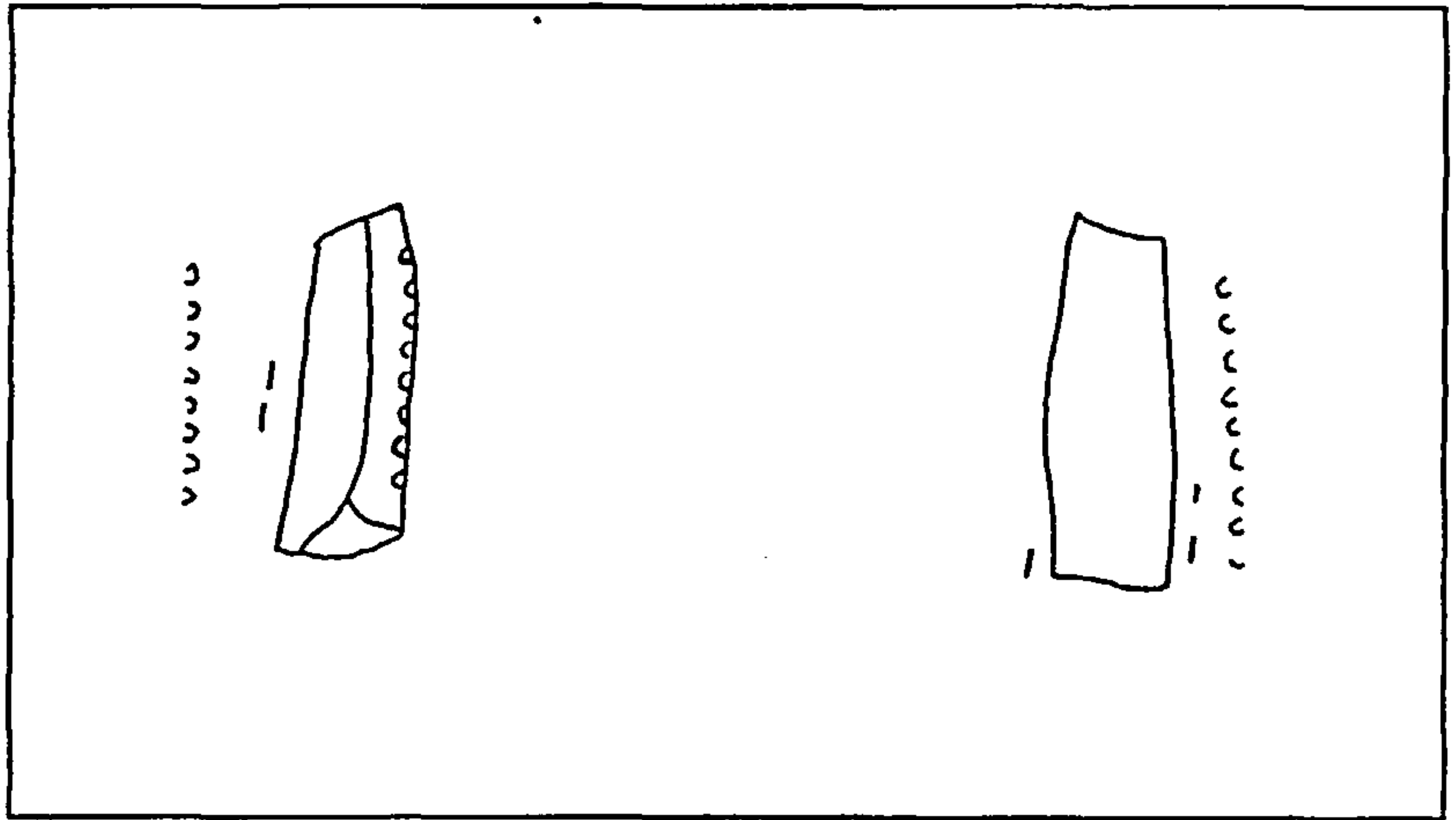
Dorsal, side a: frequent clustered large to medium mixed terminating mixed scars associated with A: patchy polish along edge. Polish is smooth flat, allover, developed, bright, with gradual edges and occasional large circular pits. Also with B: patchy polish along edge. Polish is smooth flat (invasive/reticulated) partially linked, developed, bright, with gradual edges and occasional large circular pits. Associated are parallel medium cross clustered frequent striations.

Ventral, side a: frequent clustered large to small mostly step terminating mostly deep scars associated with A and B and with C: broad spread along edge. Polish is reticulated, partially linked, with gradual edges and no internal features.

Interpretation: side a used, long motion, not hard material

Comments: C>>B>>A = development sequence

Ref: SM110
Type: ED
Blank: BLADE
Mat: CHERT
Dim: 17x7x3
Qual: MED
Cond: FRESH



Material: Grain: F Homog: V Crys: C Topo: F Fissures:
A

Edge Angle: acute

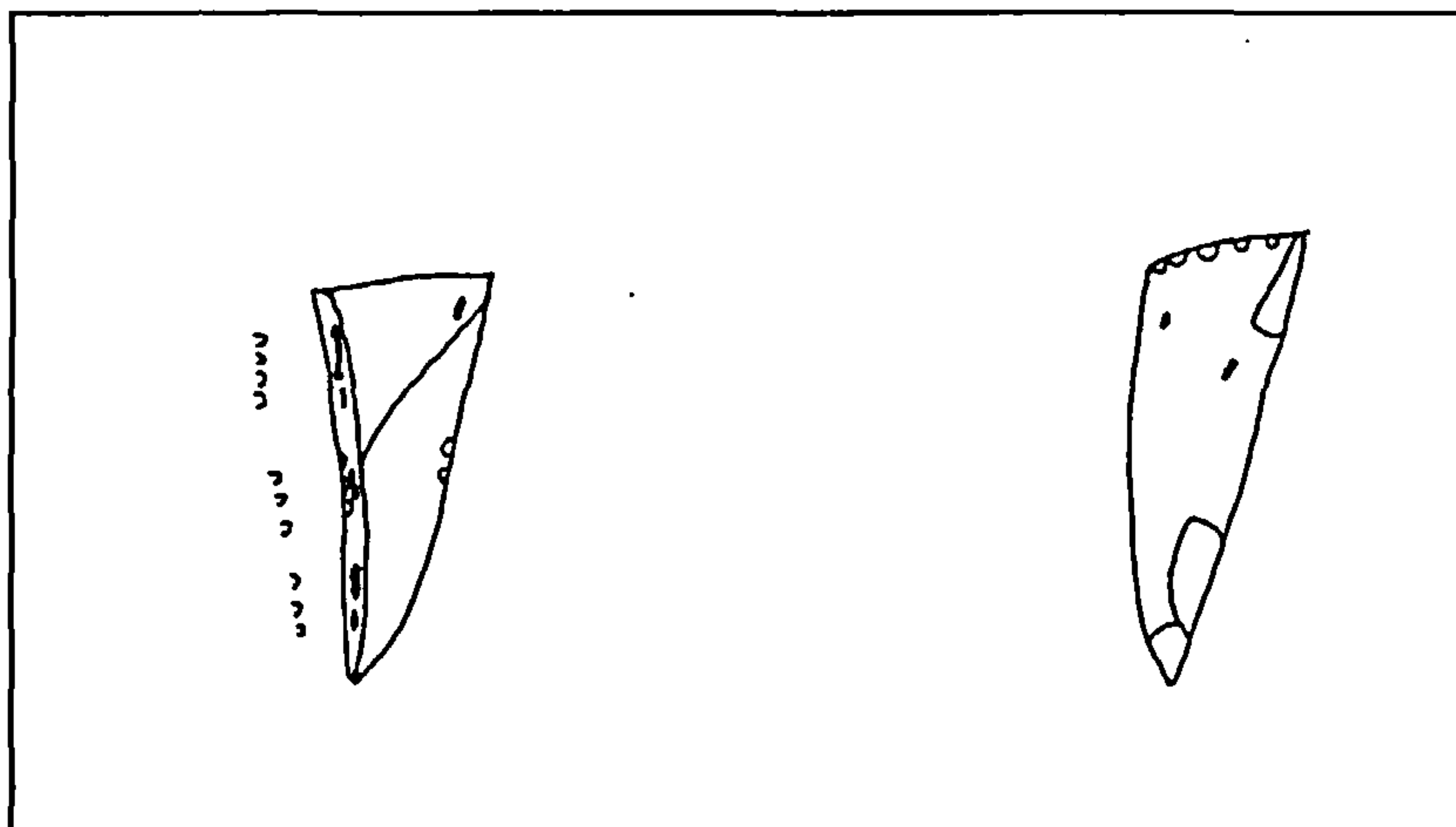
Traces:

Side a, both faces: common clustered small mostly feather terminating mostly deep scars associated with restricted patchy polish along edge. Polish is smooth domed allover, developed, with sharp edges and occasional small circular pits. In and around edge damage.

Side b, ventral: small spot of patchy polish along edge. Polish is smooth invasive, partially linked, with gradual edges and occasional small circular pits

Interpretation: opp use, bifacial = longitudinal
Comments:

Ref: SM130
Type: ED
Blank: BLADE
Mat: FLINT
Dim: 26x11x8
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures: A

Edge Angle: medium

Traces:

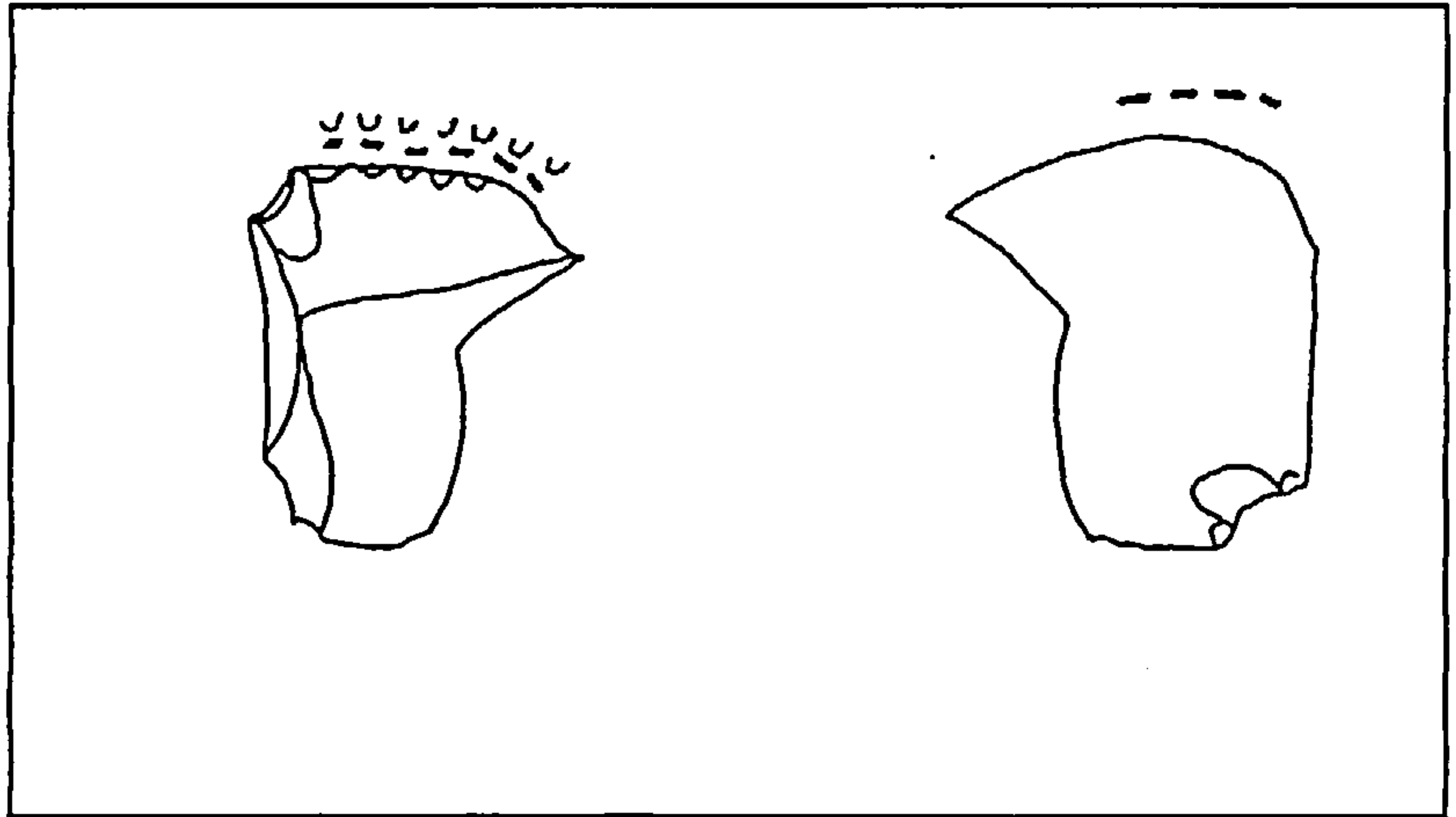
Dorsal, side a: numerous clustered and layered large to medium step terminating deep scars associated with spread of patches of polish on interior. Polish is smooth flat (domed), partially linked, developed. bright, with sharp edges, and frequent parallel linear features. Associated with polish are parallel and 45° long deep medium and narrow cross clustered frequent striations.

Both dorsal and ventral interior faces: patchy polish on interior. Polish is rough reticulated, partially linked, with sharp edges and no internal features.

Interpretation: Interior face polish = techno, bipolar technique traces. Side b = used, long motion, hard mat, but difficult to interpret

Comments: strike-a-light, pos bipolar too, but never seen experimentally

Ref: SM131
Type: ED
Blank: FLAKE
Mat: FLINT
Dim: 26x23x6
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A

Edge Angle: acute

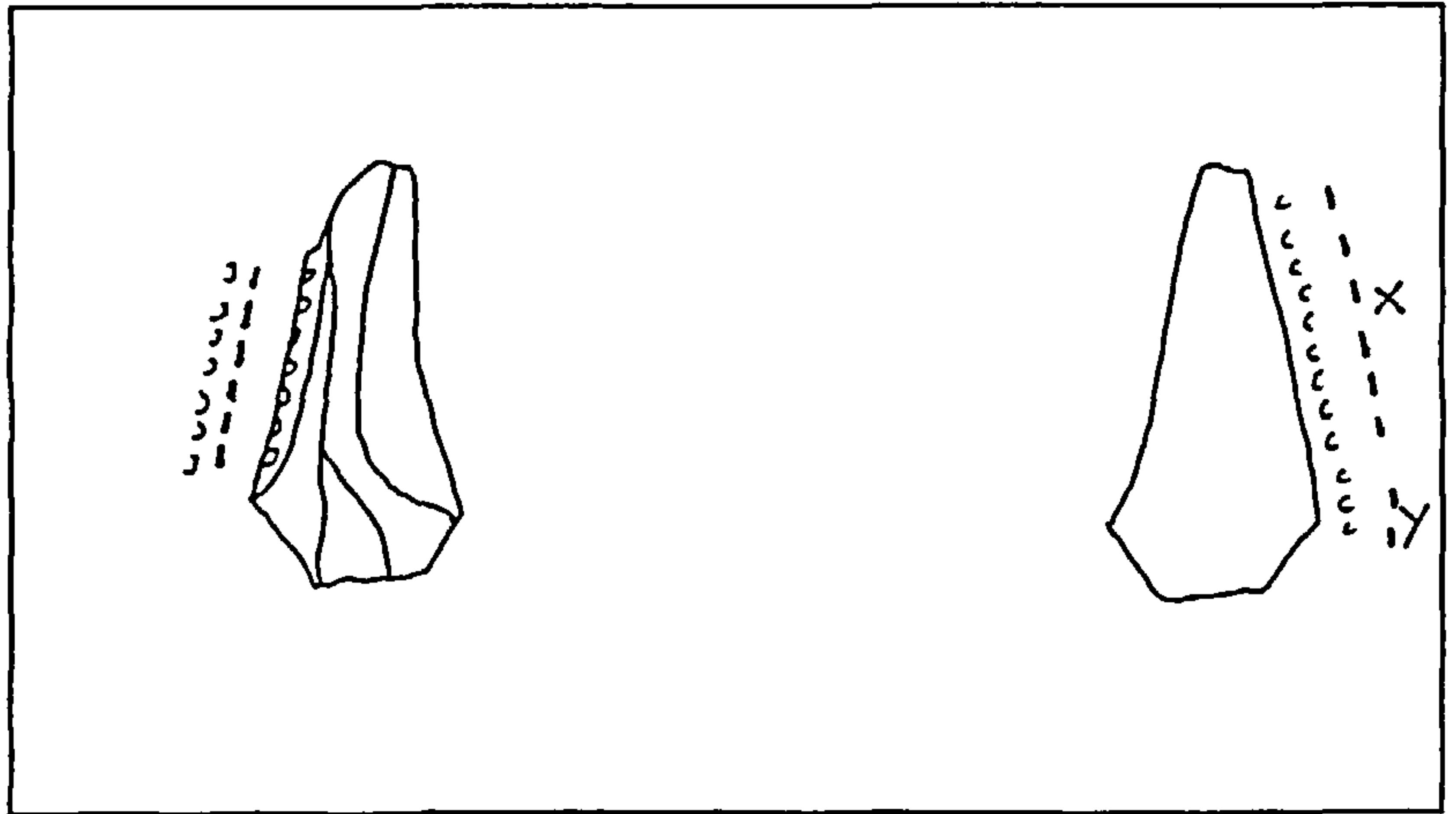
Traces:

Dorsal distal: frequent clustered large mixed termination deep scars with snaps, associated with restricted patches of polish on edge. Polish is rough reticulated, scattered, poor, with fairly sharp edges and no internal features

Ventral distal: no edge damage, restricted narrow linear polish along edge. Polish is smooth domed, partially linked, with gradual edges and no internal features. Associated are perpendicular short deep fine scattered striations.

Interpretation: distal used, transverse action
Comments: edge still sharp, not scrape (=shave)

Ref: SM146
Type: ED
Blank: FLAKE
Mat: CHERT
Dim: 20x12x4
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
C

Edge Angle: thick

Traces:

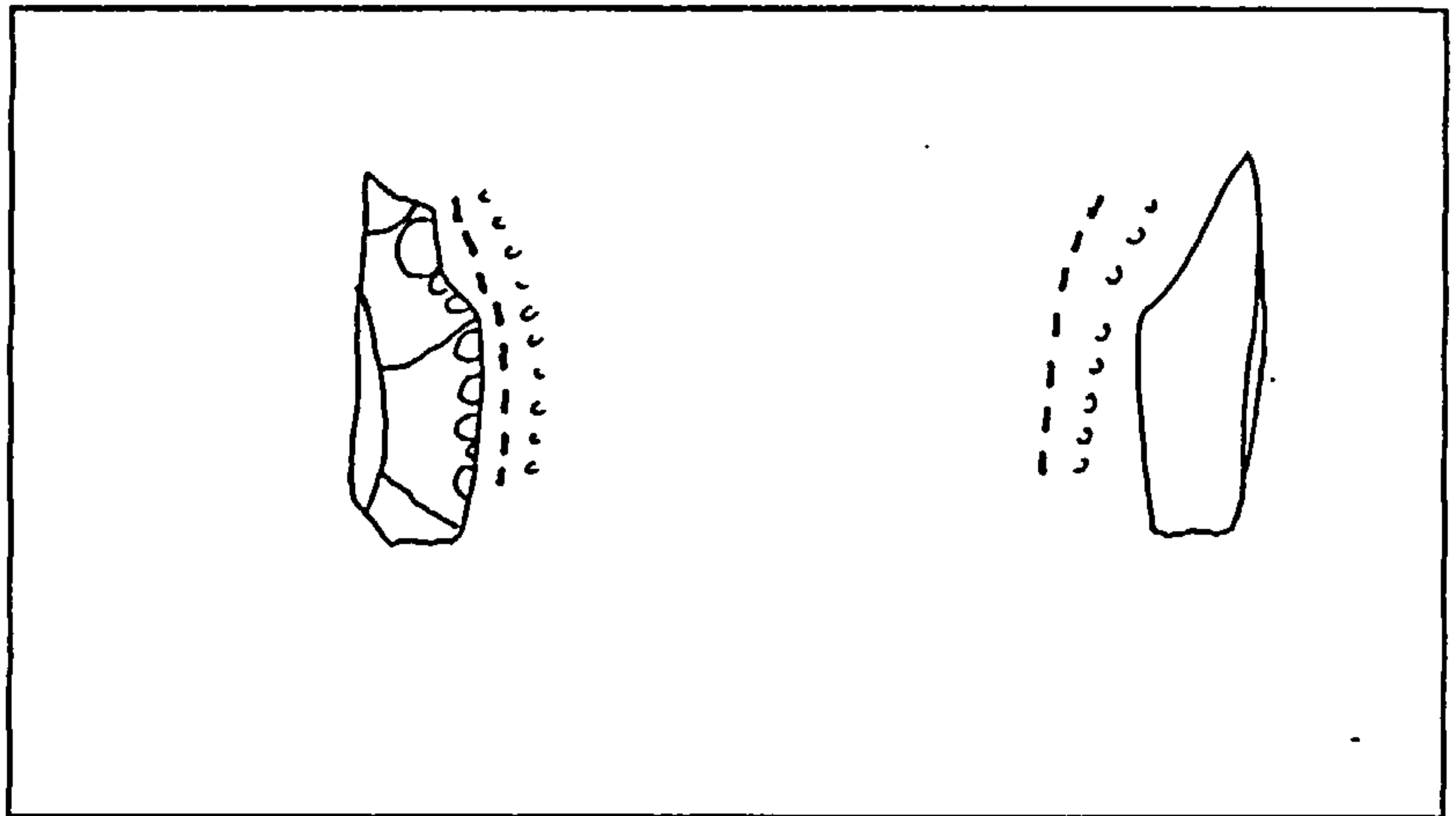
Dorsal side a, and ventral at Y: Numerous clustered and layered small mostly step terminating deep scars, associated with a broad spread of polish along and away from the edge. Polish is domed and invasive, partially linked, developed, variable with fairly gradual edges and rare minute irregular pits. Associated are parallel short, shallow, fine, clustered striations.

Ventral side a at X: frequent clustered small to minute step terminating deep scars associated with a broad spread of polish along and away from edge. Polish is smooth reticulated, scattered, poor, variable with gradual edges and no internal features.

Interpretation: side a used. Bifacial wear = long motion, deep penetration

Comments: variation between dorsal and ventral explained by thick section. Dorsal provides more resistance >> more developed traces

Ref: SM148
Type: ED
Blank: BLADE
Mat: CHERT
Dim: 19x8x5
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
O

Edge Angle: medium

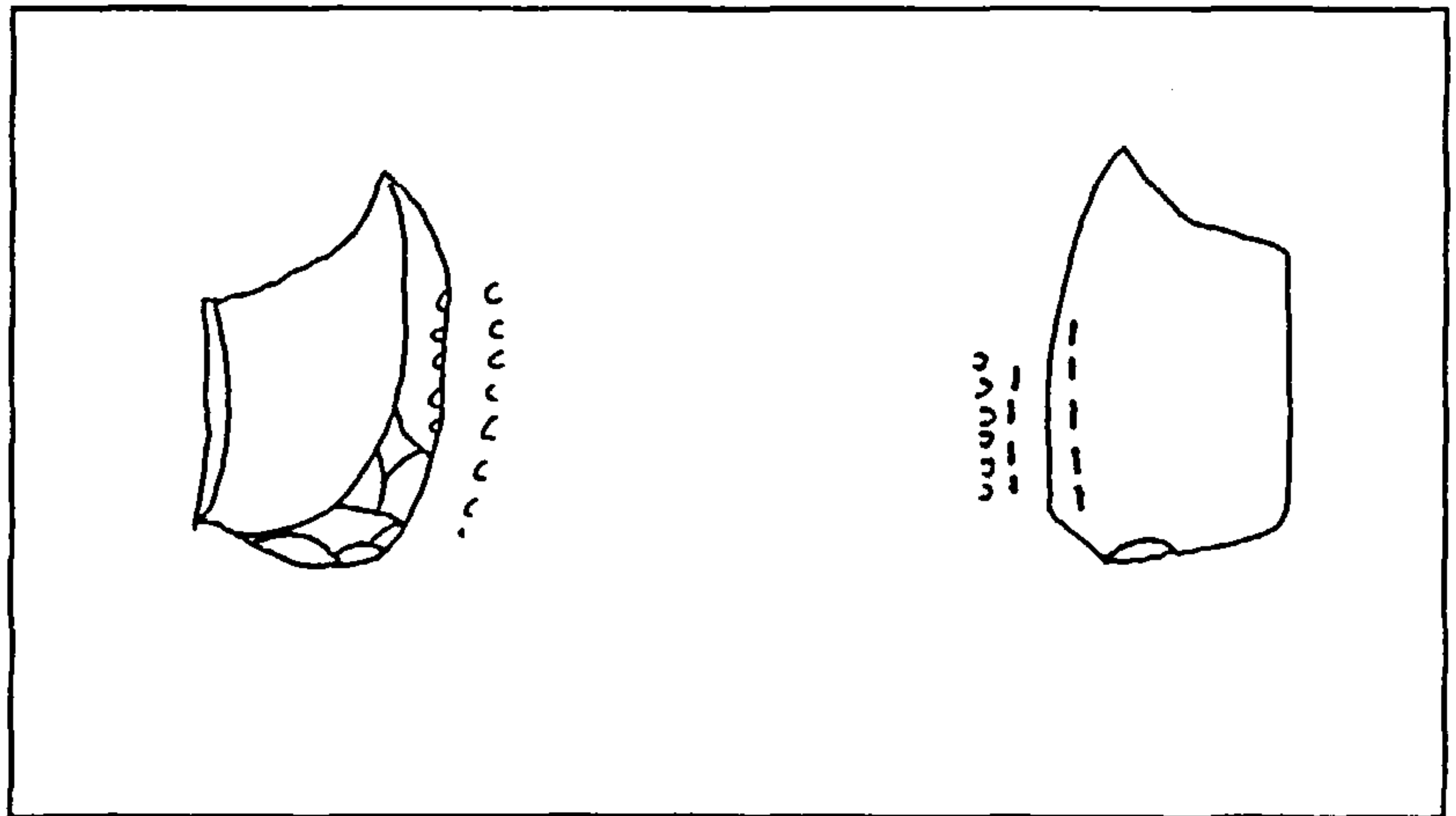
Traces:

Side b, both faces: numerous clustered and layered large step terminating mixed scars associated with a broad spread of polish along the edge. Polish is smooth domed (and invasive), partially to all over linked, developed, variable with gradual edges and occasional small circular pits.

Interpretation: side b used. Bifacial = long motion, edge damage suggests hard material

Comments: other complicated traces, cannot explain - possibly hafting. Nice example of differential polish development in different scars

Ref: SM151
Type: ED
Blank: FLAKE
Mat: FLINT
Dim:
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: R Fissures: A

Edge Angle: medium

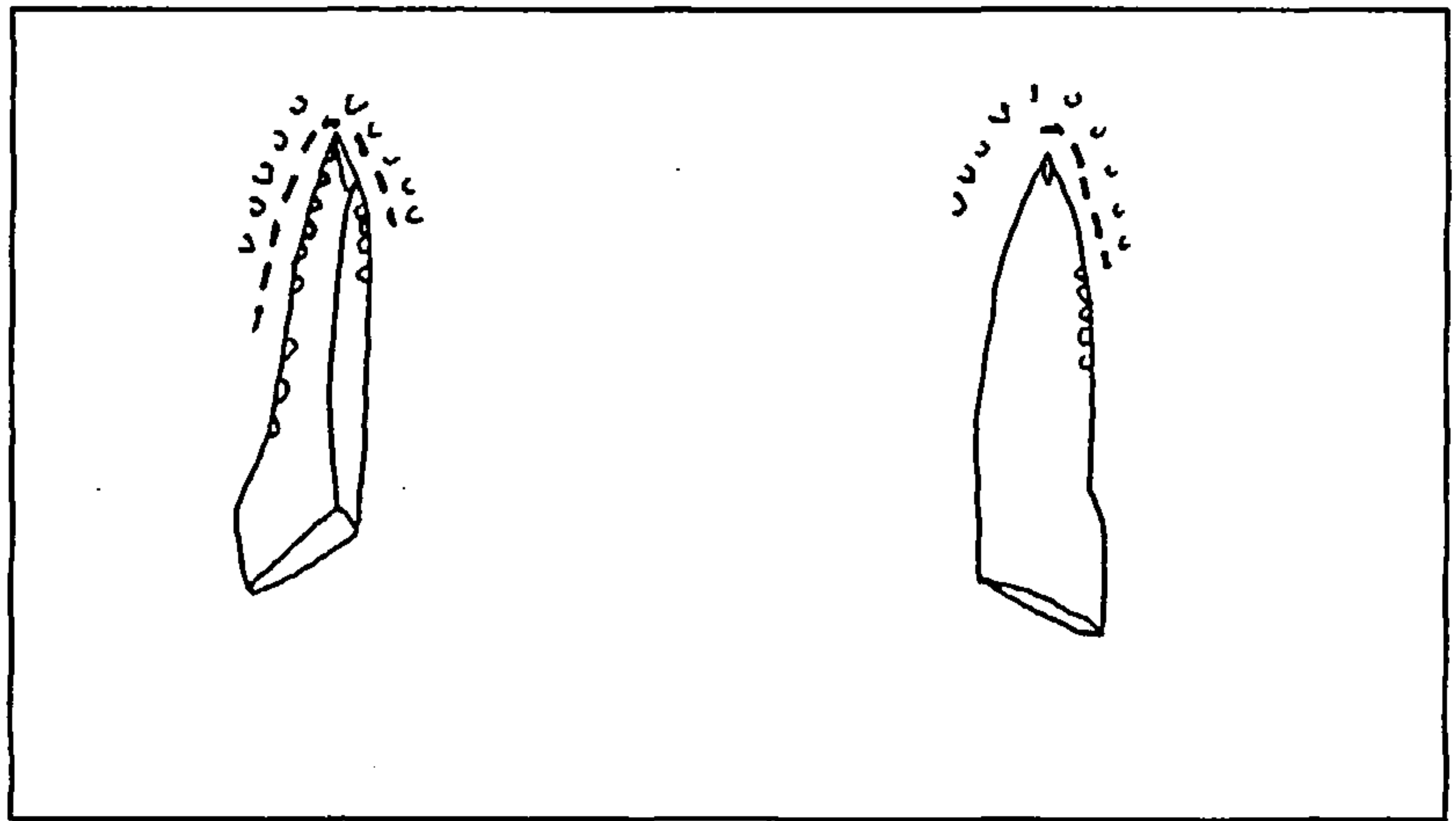
Traces:

Dorsal, side b: common to frequent clustered and layered large to medium mostly feather terminating deep scars, associated with no polish

Ventral side b: occasional scattered small to minute feather terminating deep scars associated with A: restricted linear polish away from edge. Polish is smooth invasive, with fairly gradual edges and occasional small circular pits. Also with B: broad spread of polish along edge. Polish is smooth, reticulated, scattered, poor, with gradual edges and occasional small circular pits.

Interpretation: side b used. Transverse, soft material
Comments:

Ref: SM162
Type: ED
Blank: BLADE
Mat: FLINT
Dim: 28x10x4
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A

Edge Angle: point

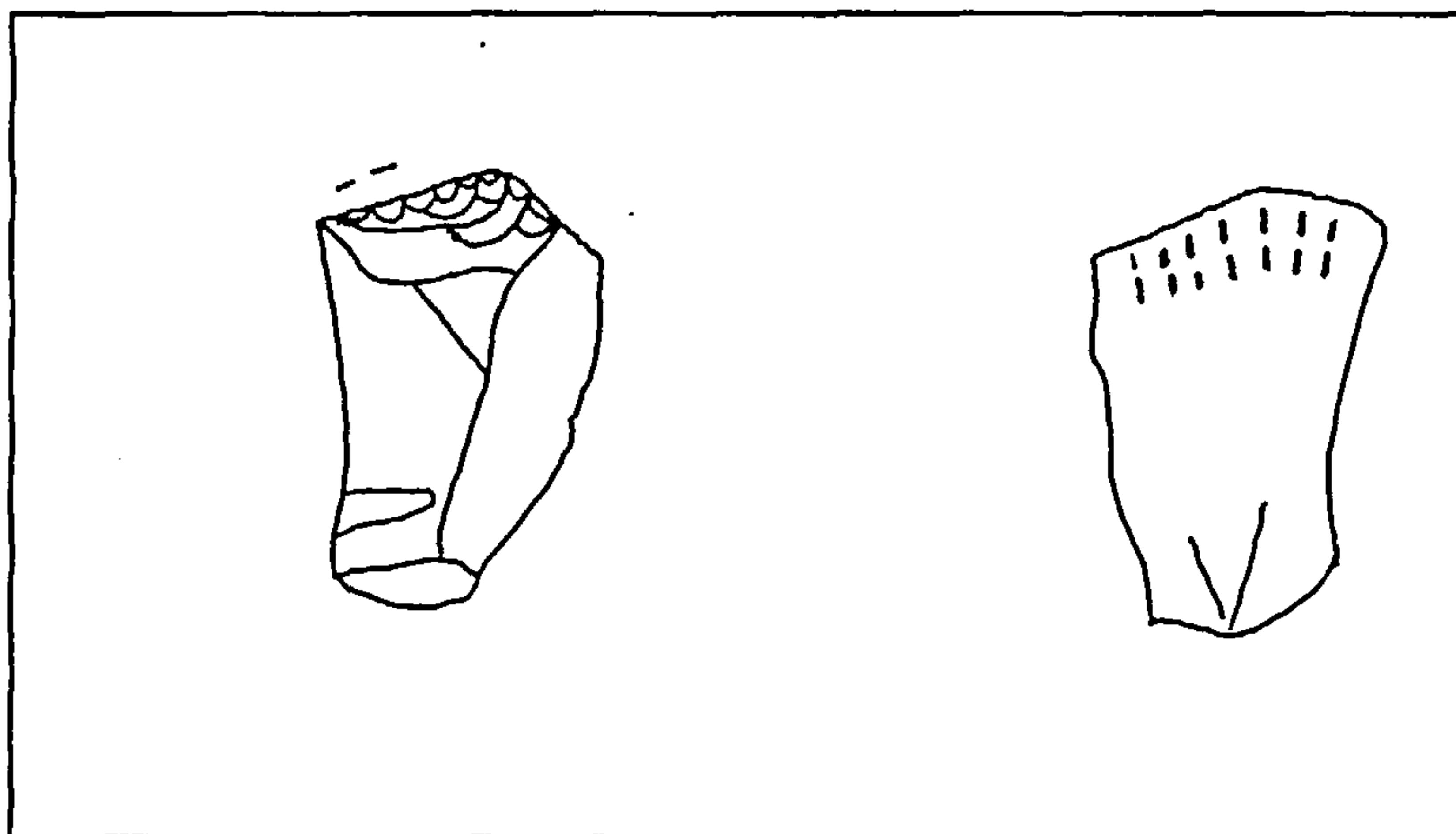
Traces:

Dorsal distal point and associated edges: numerous clustered large mostly step terminating deep scars with snaps, associated with B: patchy polish along edge. Polish is smooth invasive, partially linked, variable with gradual edges and common small irregular pits. Also with C: patchy polish along edge. Polish is smooth domed and invasive, partially linked, with gradual edges and common small irregular pits. Associated with C are random medium deep broad random clustered frequent striations.

Ventral distal point and associated edges: frequent clustered large step terminating deep scars associated with A: patchy spread of polish away from edge. Polish is smooth domed and invasive, partially linked, developed, variable with gradual edges and no internal features. Also with D: restricted patches of polish on edge. Polish is smooth flat, allover, intense, bright, with abrupt edges and no internal features

Interpretation: Distal point used, complex
Comments: Not drilling or rotary use, possible variable/multiple use in a single task

Ref: SM163
Type: SCRAPER
Blank: FLAKE
Mat: FLINT
Dim: 23x17x8
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A

Edge Angle: thick

Traces:

Edge damage not noted due to retouch

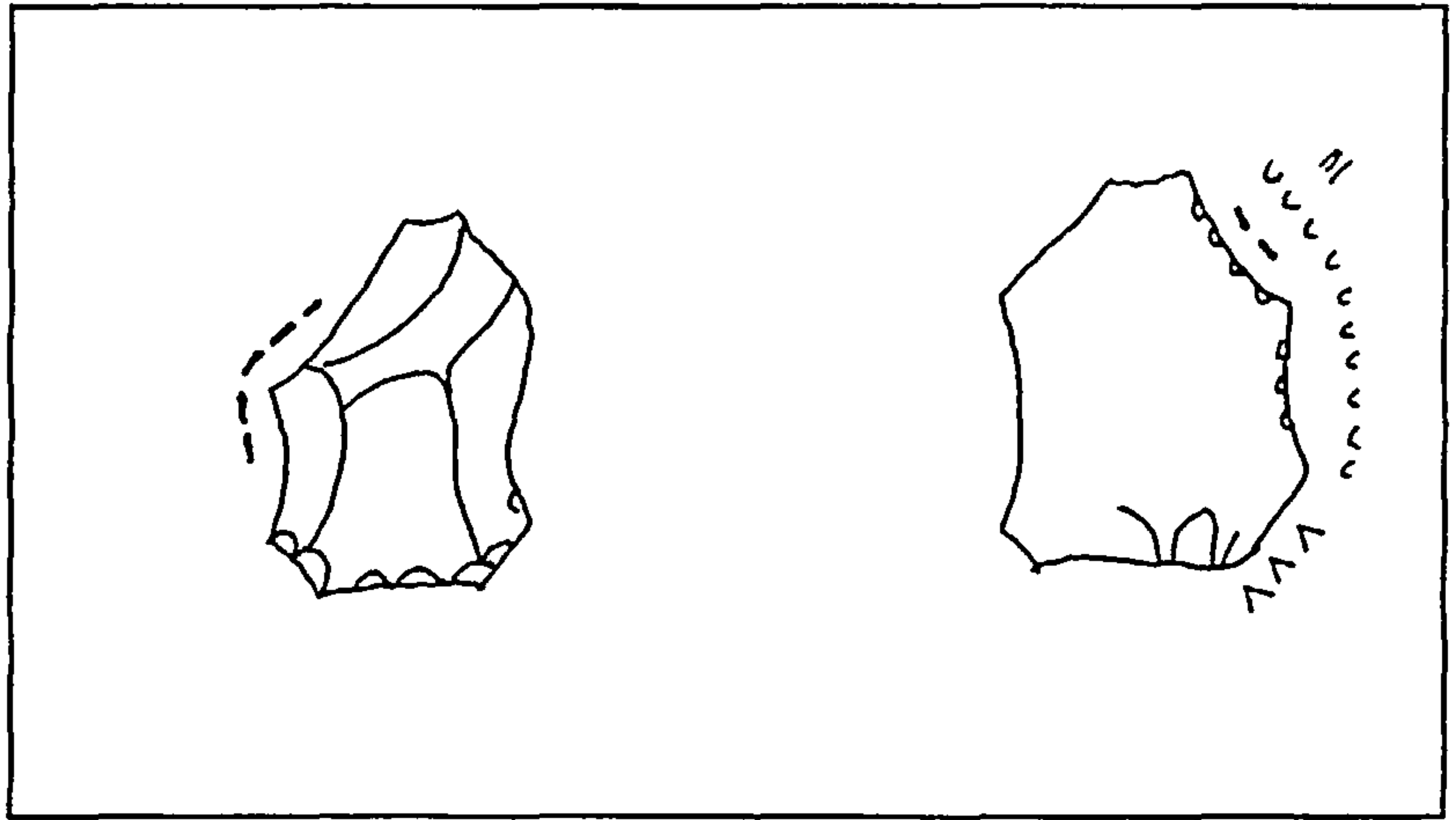
Dorsal distal: restricted patchy polish along edge. Polish is smooth domed and invasive, allover, developed, with gradual edges and no internal features. Forms an edge bevel on extreme edge, and on some of the retouch arretes.

Ventral distal: Broad spread of patchy, partially linear polish away from edge. Linearity is perpendicular to edge. Polish is smooth flat reticulated, scattered, developed, bright with abrupt edges and occasional small irregular pits.

Interpretation: Distal used, transverse, low angle, medium hardness

Comments:

Ref: SM164
Type: ED
Blank: FLAKE
Mat: FLINT
Dim: 20x21x5
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A

Edge Angle: acute

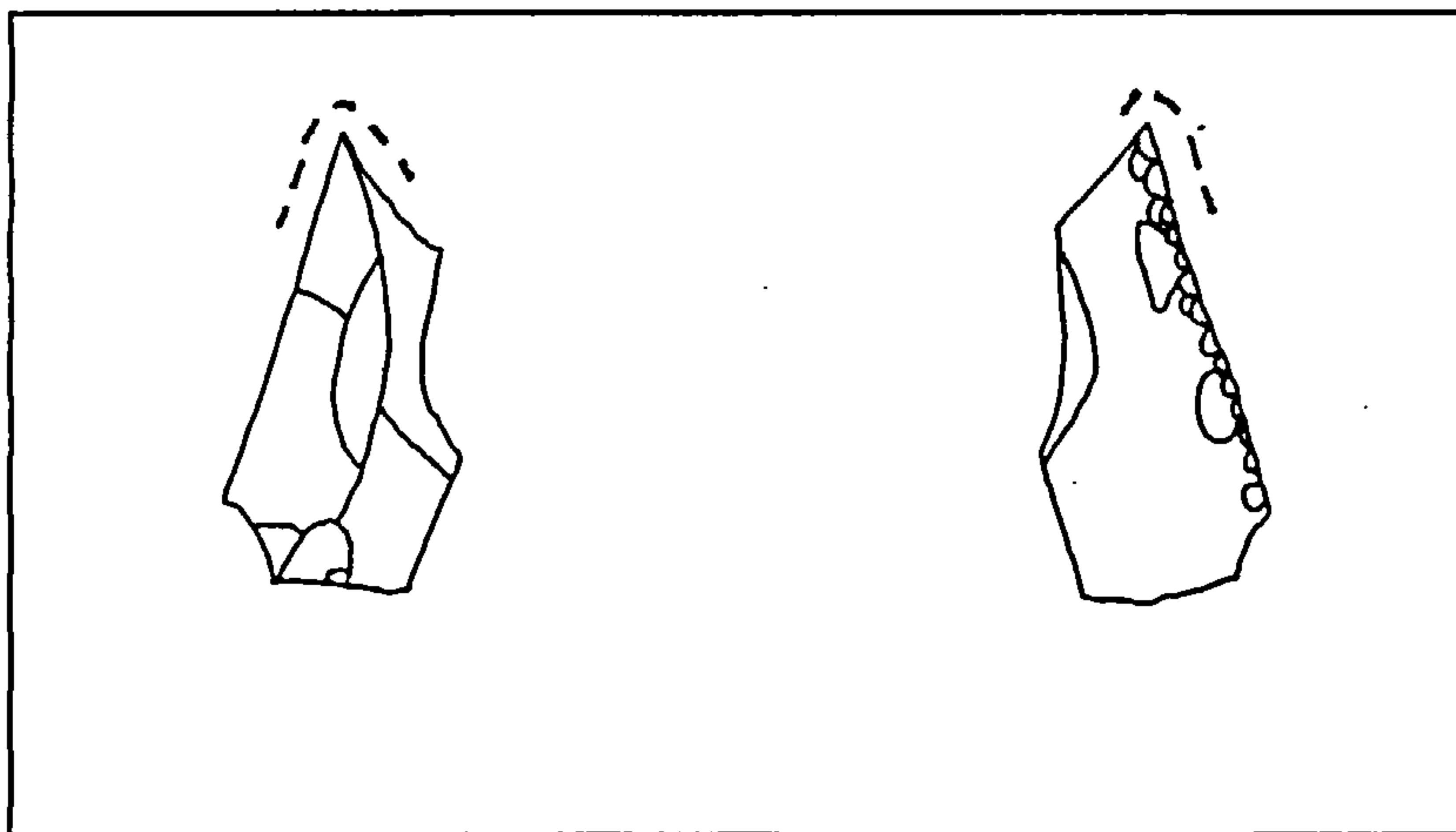
Traces:

Dorsal side a: no edge damage. Restricted narrow linear polish along edge. polish is smooth domed, partially linked, with sharp edges and no internal features.

Ventral side a: common clustered large mostly feather terminating mostly deep scars associated with restricted patchy polish along edge. Polish is smooth domed, partially linked, with sharp edges and occasional small irregular pits. Associated are perpendicular short medium fine clustered striations.

Interpretation: side a used, transverse, minor/opp
Comments: although traces are not entirely unifacial, striations support transverse interpretation

Ref: SM191
Type: SCRAPER
Blank: FLAKE
Mat: FLINT
Dim: 30x16x8
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: thick

Traces:

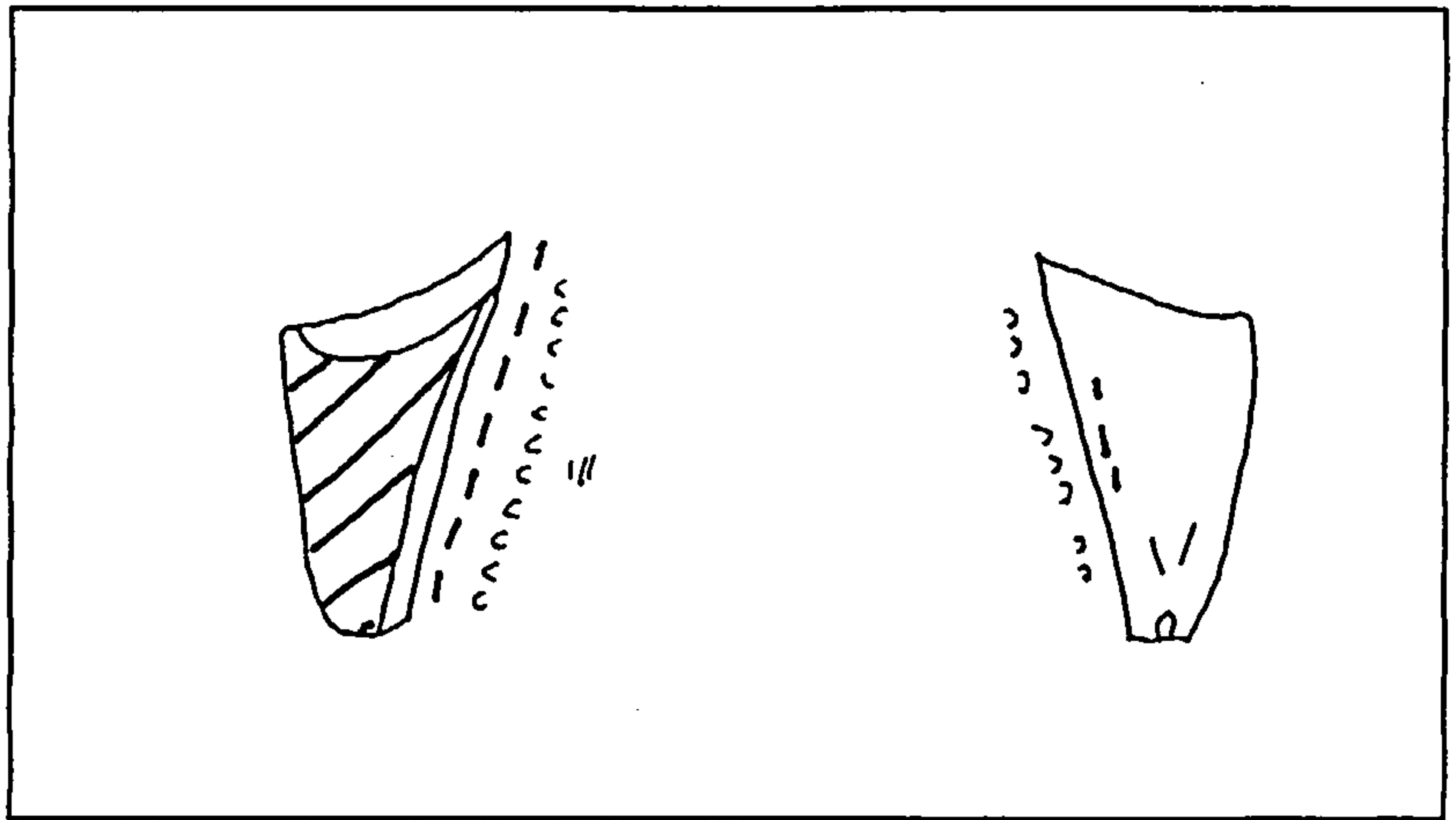
Edge damage not recorded because of retouch

Dorsal distal: A: restricted patchy polish along edge. Polish is smooth flat, partially linked, developed, bright, with sharp edges and common medium irregular pits. B: Patchy medium linear polish along edge. Polish is smooth domed and invasive, partially linked, with gradual edges and no internal features. C: Medium linear polish away from edge (on retouch arretes). Polish is smooth domed (and invasive), developed, with soft edges and occasional small circular pits. D: restricted narrow linear polish along edge. Polish is smooth domed, allover, with gradual edges and no internal features.

Ventral distal: Polish C

Interpretation: distal used, transverse motion
Comments: nose scraper in function

Ref: SM193
Type:
Blank: FLAKE
Mat: FLINT
Dim: 25x16x5
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: medium

Traces:

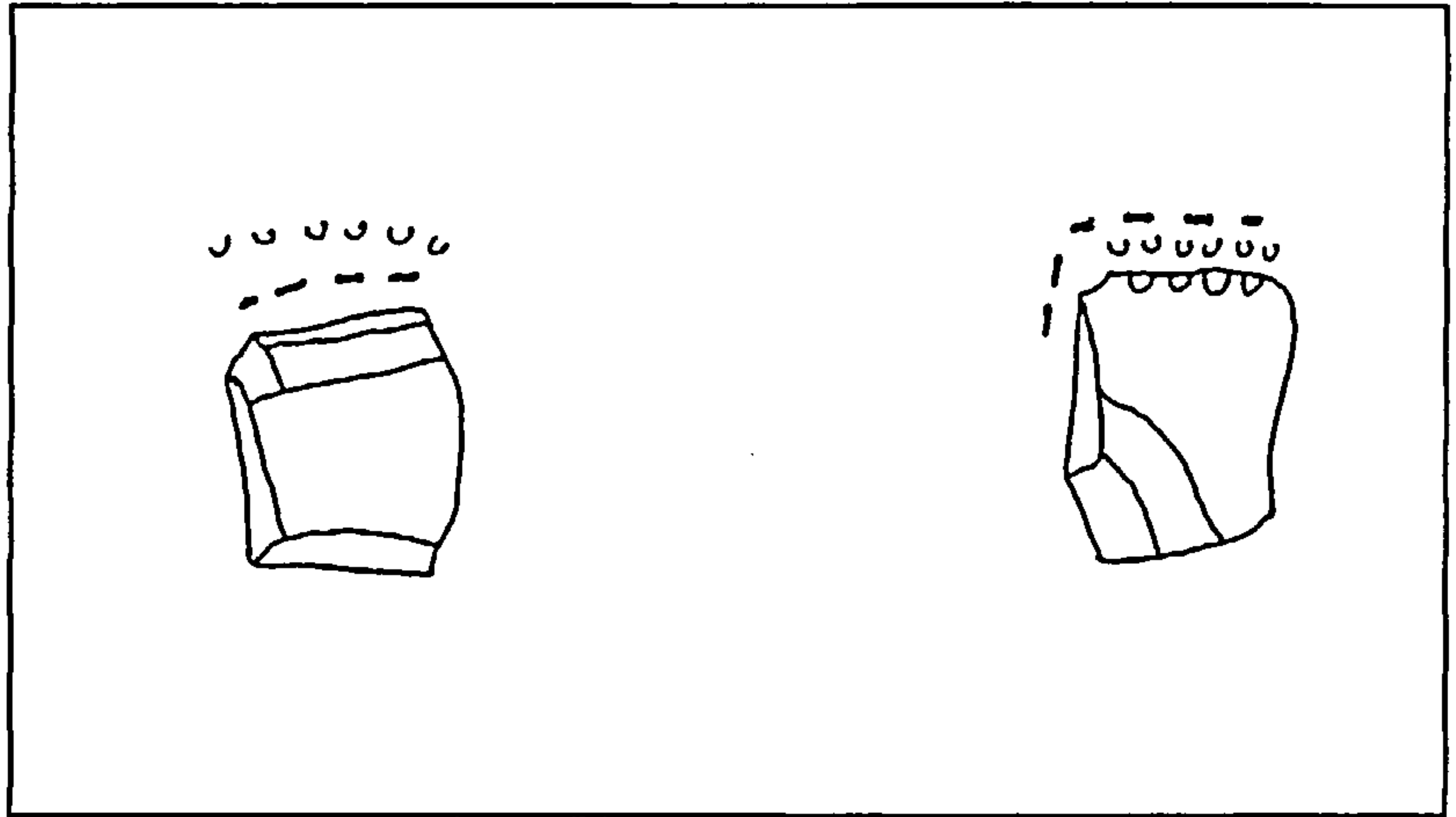
Dorsal, side b: common clustered small to minute mixed terminating mostly deep scars and rounding, associated with a restricted narrow linear polish along edge. Polish is smooth domed, partially linked, developed, with sharp edge and no internal features. Associated with parallel long deep narrow clustered common striations.

Ventral, side b: common clustered small to minute mostly feather terminating mostly deep scars and rounding associated with patchy polish away from and on edge. Polish is smooth flat reticulated, scattered, developed, with abrupt edges and no internal features.

Interpretation: side b used. Bifacial = long motion, medium soft

Comments: Traces are bifacial, although on ventral broad spread of polish, on dorsal narrower, but ,more defined polish

Ref: SM195
Type: ED
Blank: FLAKE
Mat: CHERT
Dim: 19x15x6
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: thick

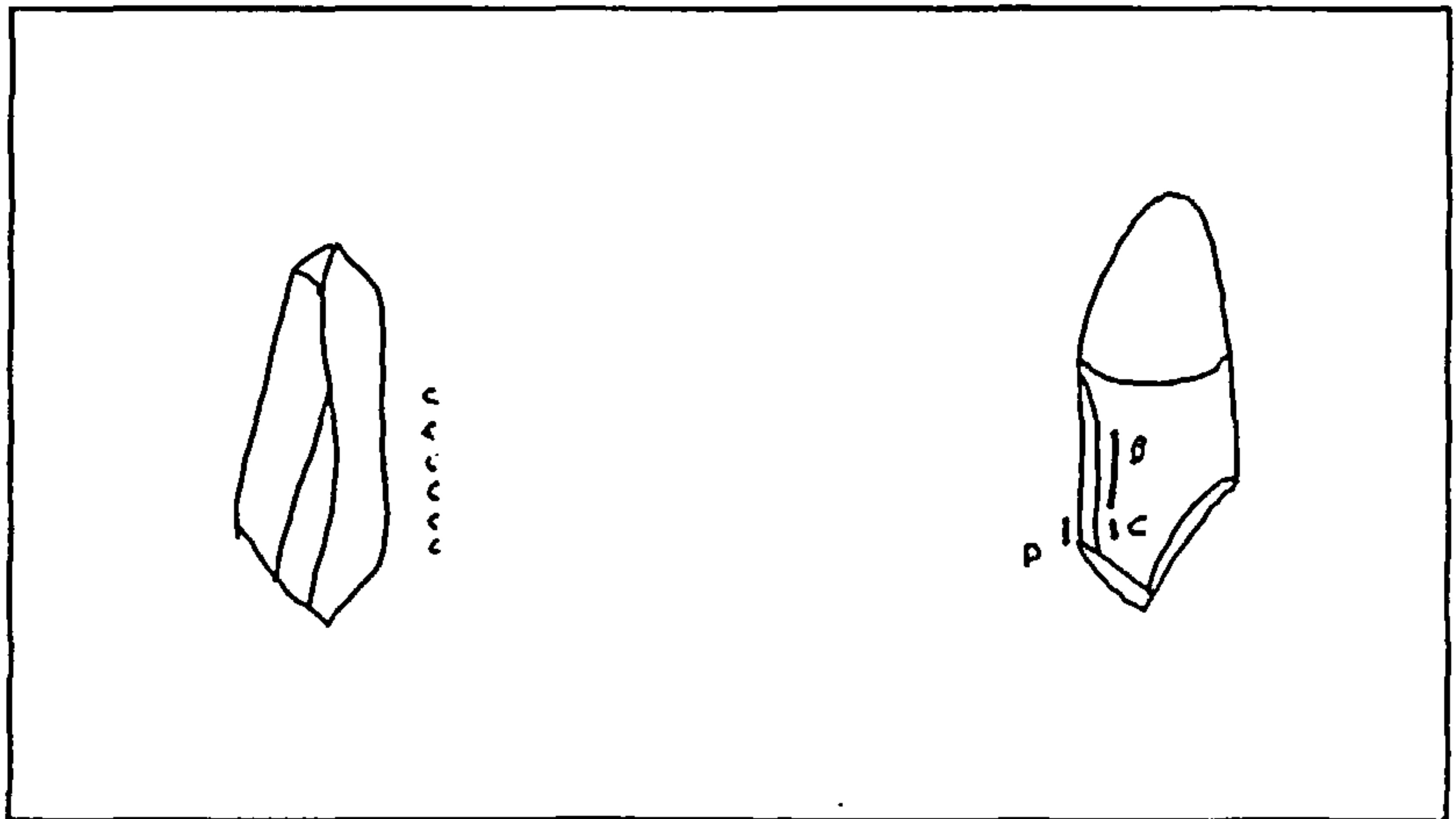
Traces:

Dorsal distal: occasional clustered medium to small mostly step terminating mostly shallow scars associated with A: patchy, (partially linear) polish along edge and away from edge. Polish is smooth domed (and invasive) partially linked, developed, with gradual edges and occasional medium circular pits. Also with B: restricted narrow linear polish away from edge. Polish is smooth domed, all over, with sharp edges and no internal features.

Ventral distal: common clustered large to medium mostly step terminating mostly shallow scars, associated with polish A. A is generally more restricted in distribution than on dorsal

Interpretation: Distal used. Probably transverse motion
Comments:

Ref: SM208
Type:
Blank: FLAKE
Mat: FLINT
Dim: 18x9x4
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures: A

Edge Angle: thick

Traces:

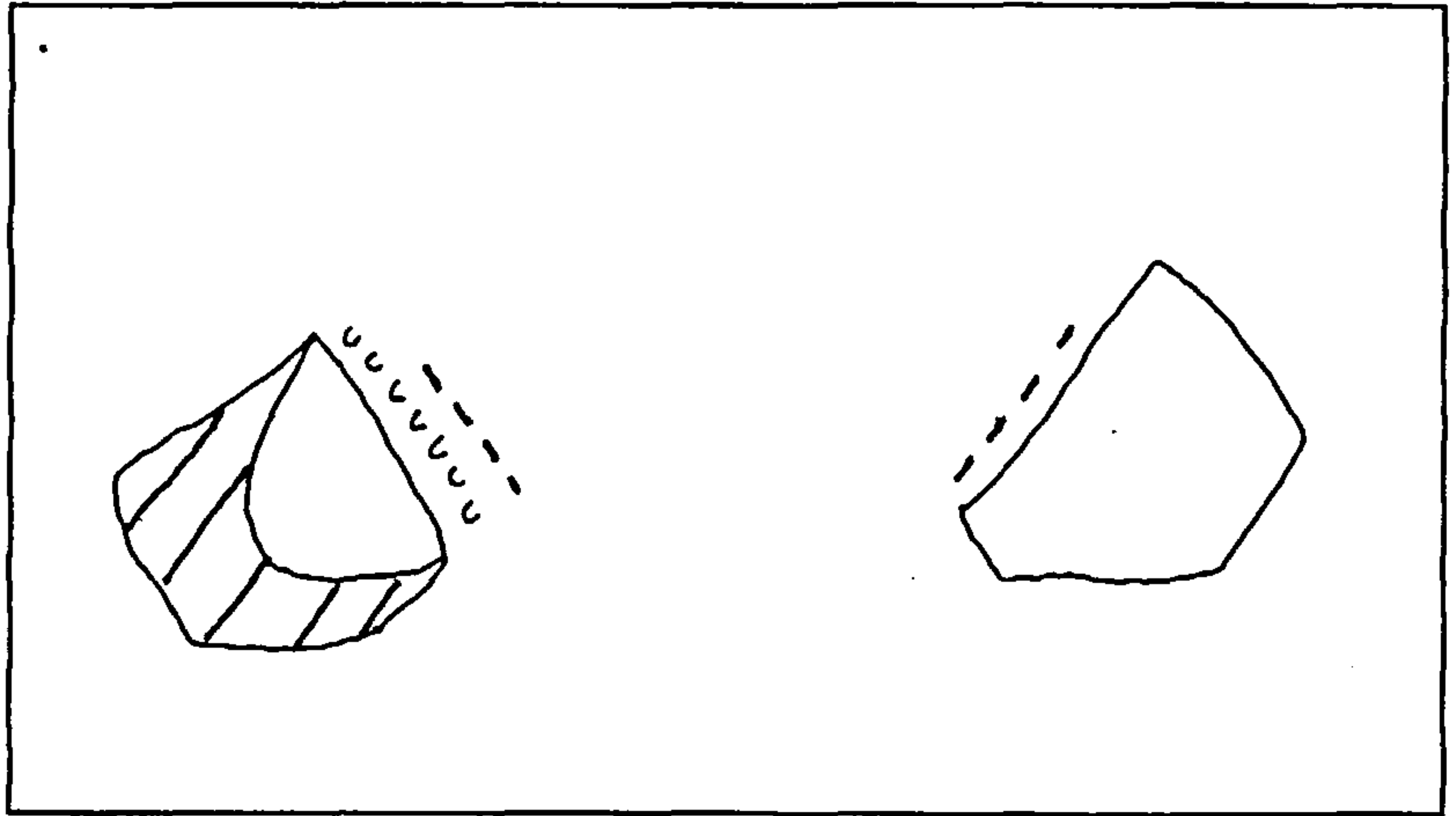
Dorsal side b: common clustered small medium mostly step terminating deep scars, no associated polish.

Ventral side b: no edge damage. B: restricted narrow linear polish. Polish is smooth domed, allover, with sharp edges and no internal features. C: Patchy spread of polish on interior. Polish is smooth flat, allover, developed, bright, with sharp edges, and occasional medium irregular pits. D: Patchy restricted polish on edge. Polish is smooth flat allover, developed, bright, with sharp edges and occasional medium irregular pits. Associated are perpendicular medium medium broad clustered frequent striations.

Other features present, prob result of bipolar knapping

Interpretation: side b used, transverse
Comments:

Ref: SM213
Type:
Blank: FLAKE
Mat: FLINT
Dim: 18x24x6
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: medium

Traces:

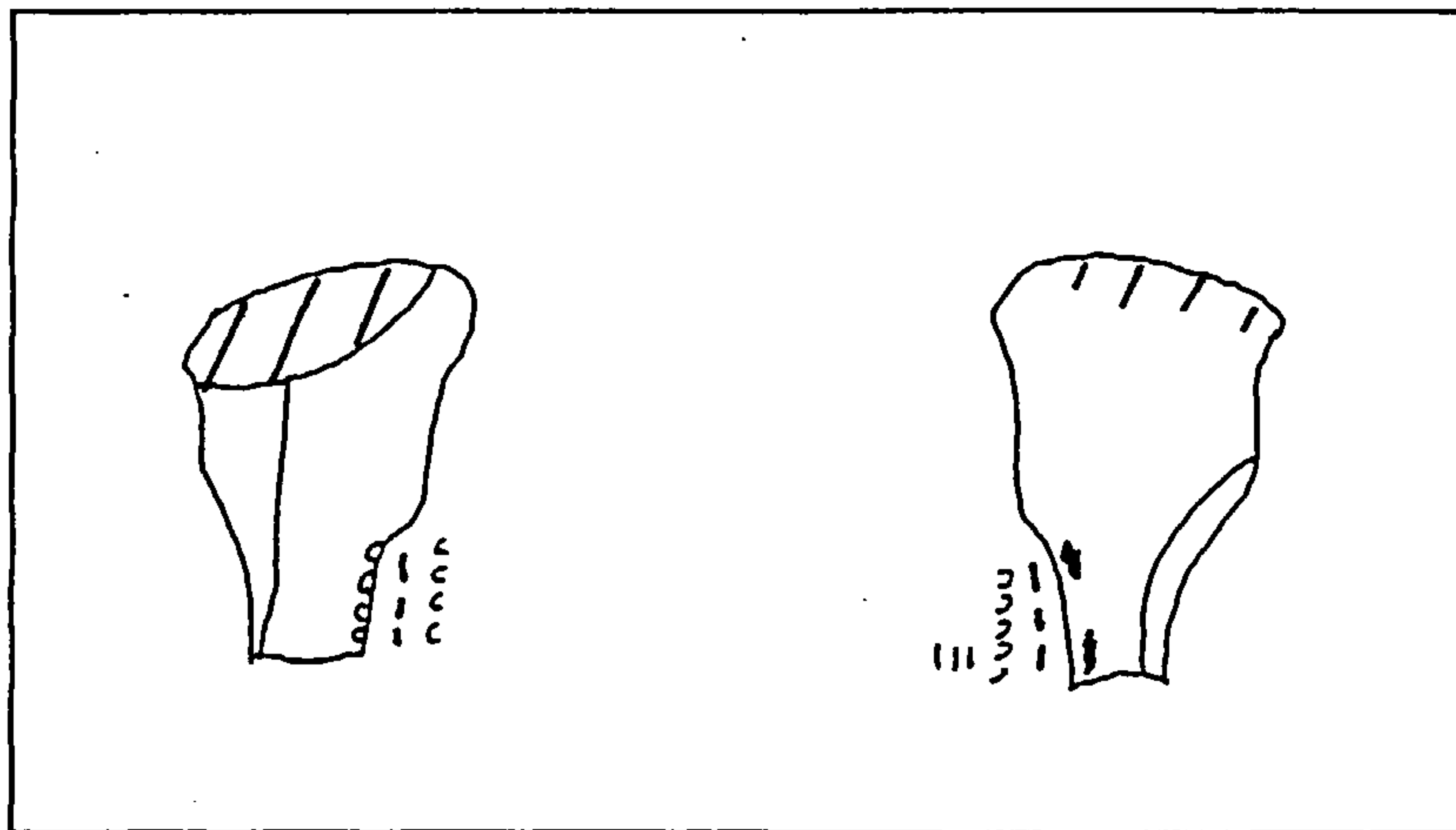
Dorsal side b: frequent clustered and layered minute mostly feather terminating mostly deep scars associated with a restricted narrow linear polish along edge. Polish is smooth domed all over, developed, with sharp edges and no internal features. Forms edge bevel. Cut by edge damage.

Ventral side b: no edge damage. Polish A

Interpretation: Side b used. Prob transverse. Opp or marginal use

Comments:

Ref: SM217
Type: ED
Blank: FLAKE
Mat: FLINT
Dim: 24x17x5
Qual: MED
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: U Fissures: A

Edge Angle: acute

Traces:

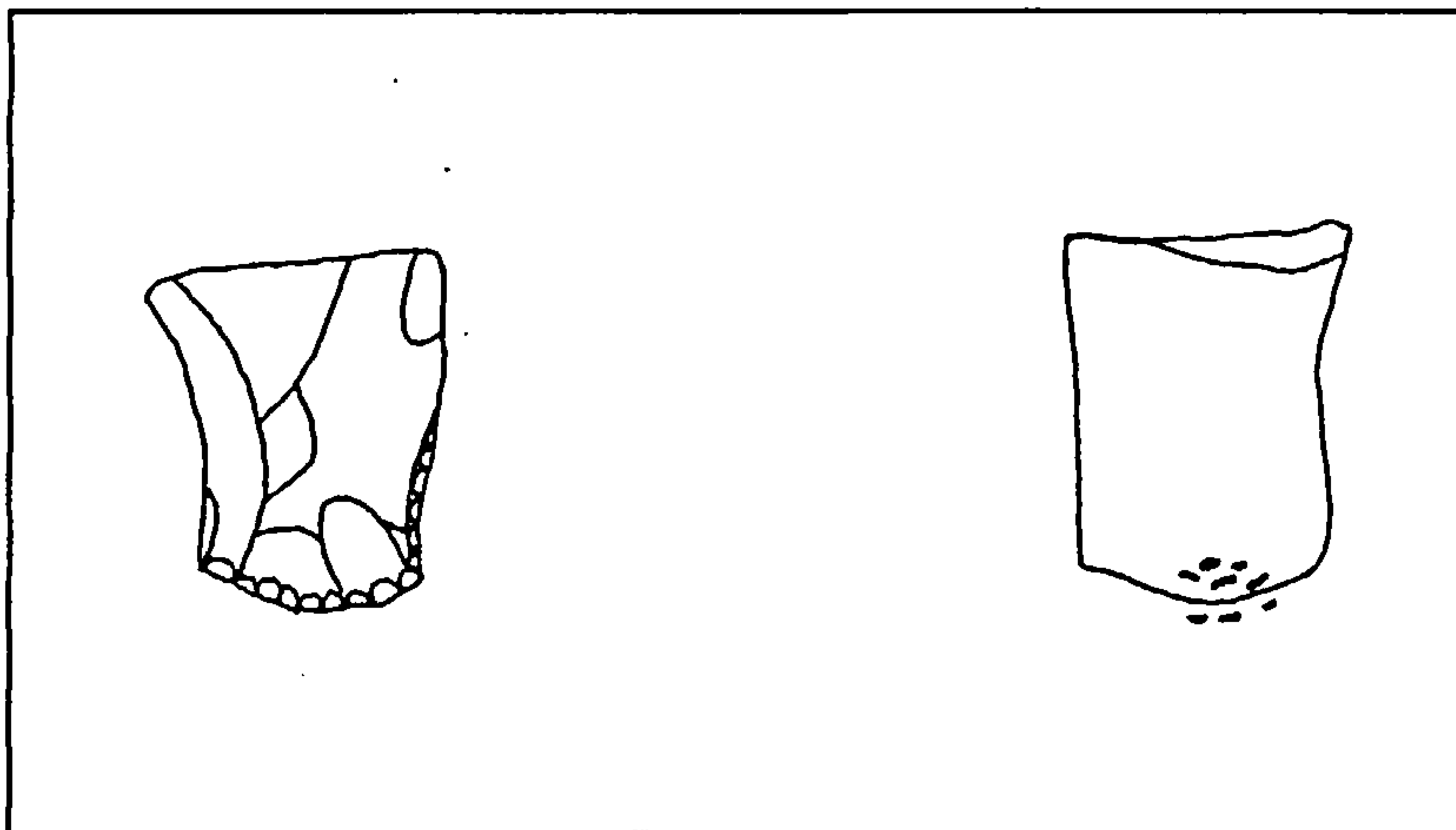
Dorsal side b: common clustered medium to small step terminating deep scars associated with a patchy spread of polish along edge. Polish is smooth domed and invasive, partially linked, developed, variable, with soft edges and no associated internal features.

Ventral side b: common clustered medium to small step terminating deep scars associated with a broad spread of polish away from the edge. Polish is smooth domed (reticulated), partially linked, developed, with fairly sharp edges and frequent small circular pits. Associated with parallel long medium narrow clustered frequent striations.

Interpretation: Side b used, longitudinal motion, heavy use, deep penetration, prob hard material.

Comments: Proximal end seems to have broken off during use

Ref: SM250
Type: SCRAPER
Blank: FLAKE
Mat: FLINT
Dim: 28x27x10
Qual: GOOD
Cond: SP



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: thick

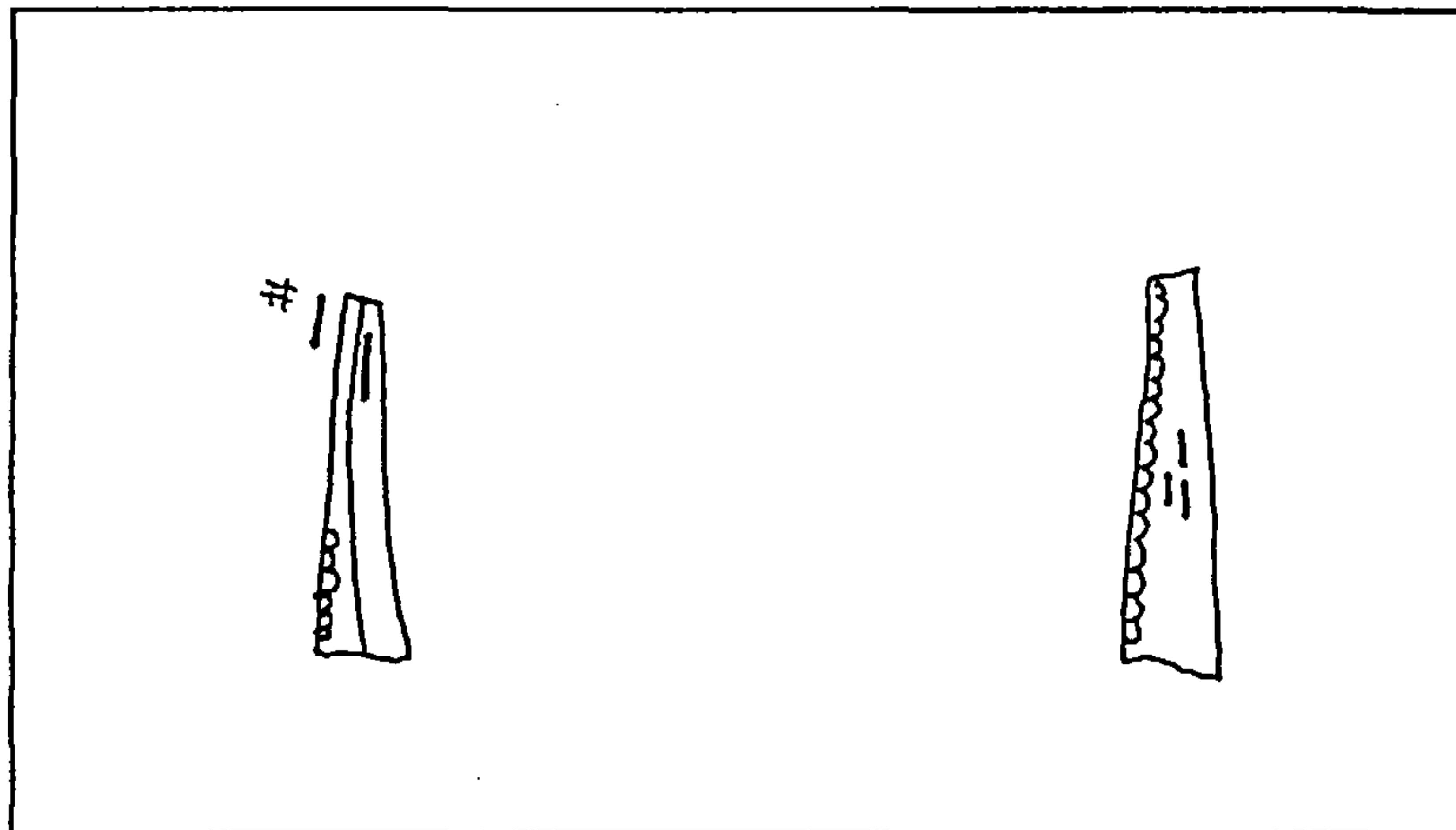
Traces:

Edge damage not recorded because of retouch

Ventral proximal: Patchy spread of polish on and away from edge. Polish is smooth flat, partially linked, developed, with sharp edges and common small irregular pits.

Interpretation: Proximal used, transverse
Comments:

Ref: SM264
Type: MICRO
Blank: BLADE
Mat: CHERT
Dim: 10x3x2
Qual: MED
Cond: FRESH



Material: Grain: M Homog: H Crys: O Topo: F Fissures: C

Edge Angle: thick

Traces:

Tip lost, edge damage difficult

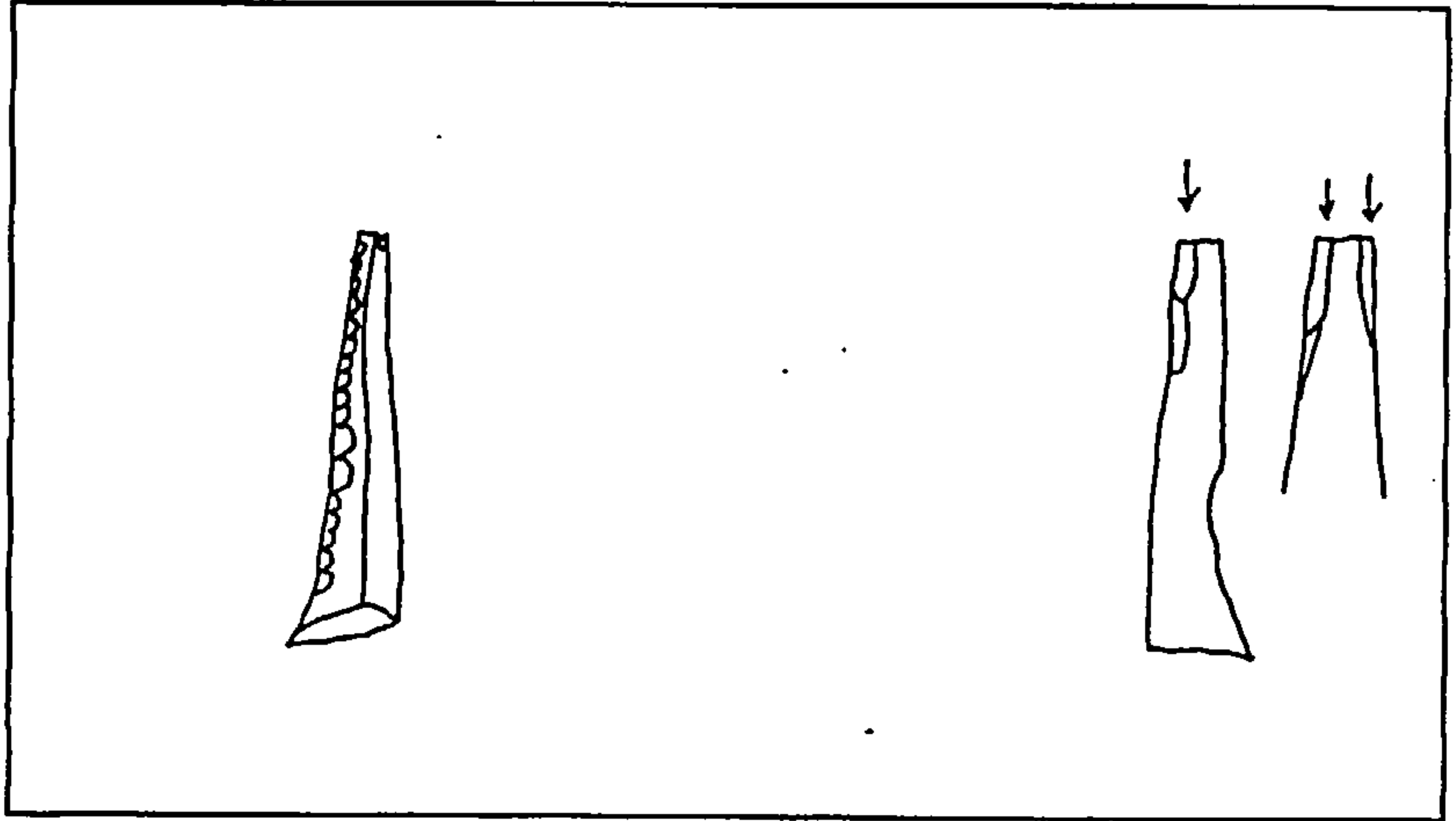
Polish B: Patchy (linear) polish on and away from edge. Polish is smooth domed, partially linked, with soft edges and common variable irregular pits. Associated with parallel and 45o deep narrow numerous striations.

Polish A: Patchy polish on interior. Polish is smooth flat reticulated, developed, with sharp edges and frequent parallel linearity. Associated with parallel long deep fine numerous striations.

Interpretation: used, projectile

Comments: not entirely convincing, lacks overall predicted linearity. Alternative involving the wear on three faces would be boring

Ref: SM300
Type: MICRO
Blank: BLADE
Mat: CHERT
Dim: 15x4x2
Qual: MED
Cond: FRESH



Material: Grain: M Homog: V Crys: C Topo: F Fissures: C

Edge Angle: point

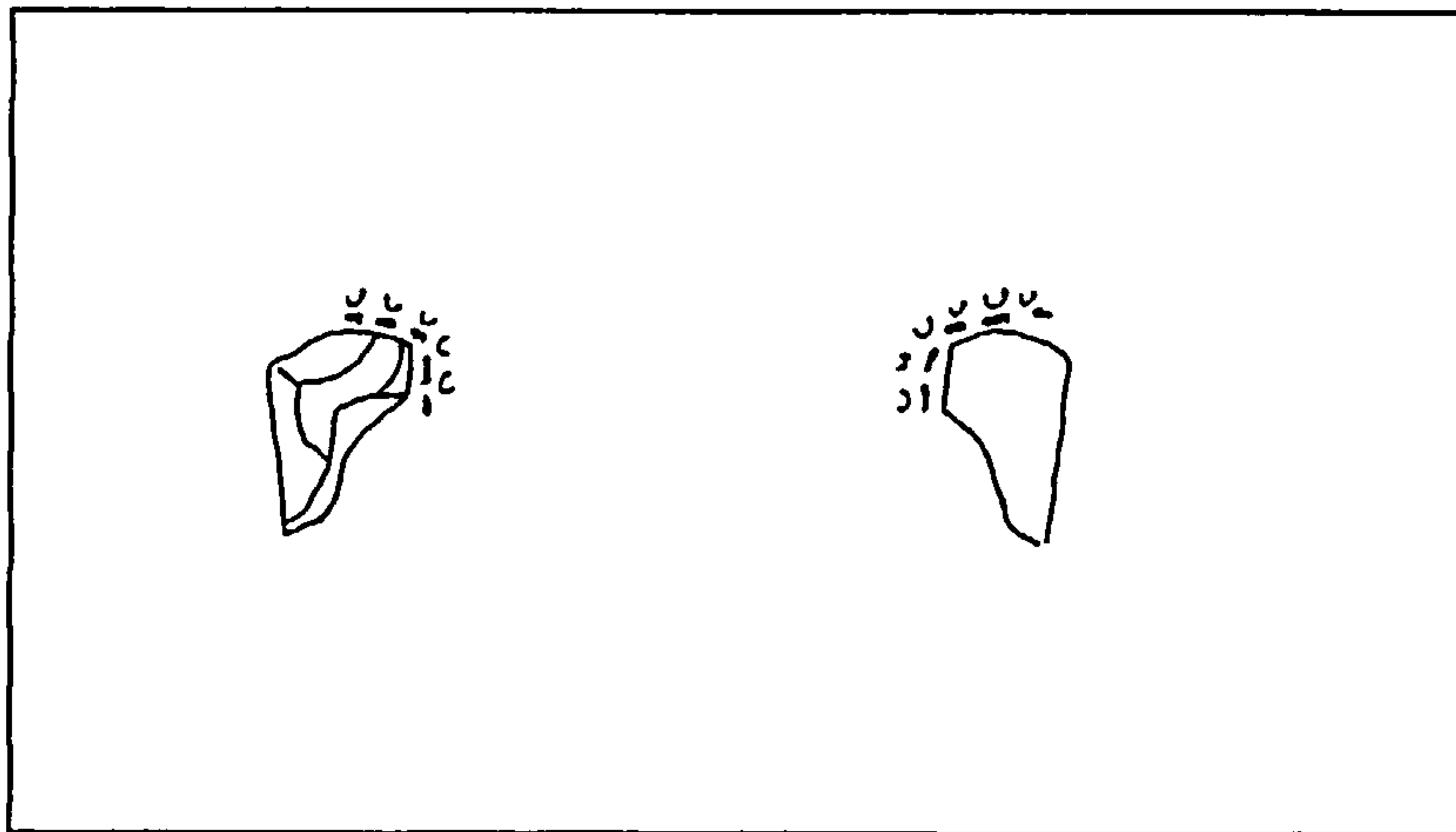
Traces:

Burin like removals and crushing at extreme tip

Interpretation: ? impact fracture = projectile use

Comments: no supporting evidence

Ref: SM314
Type:
Blank: FLAKE
Mat: CHERT
Dim: 16x10x5
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: medium

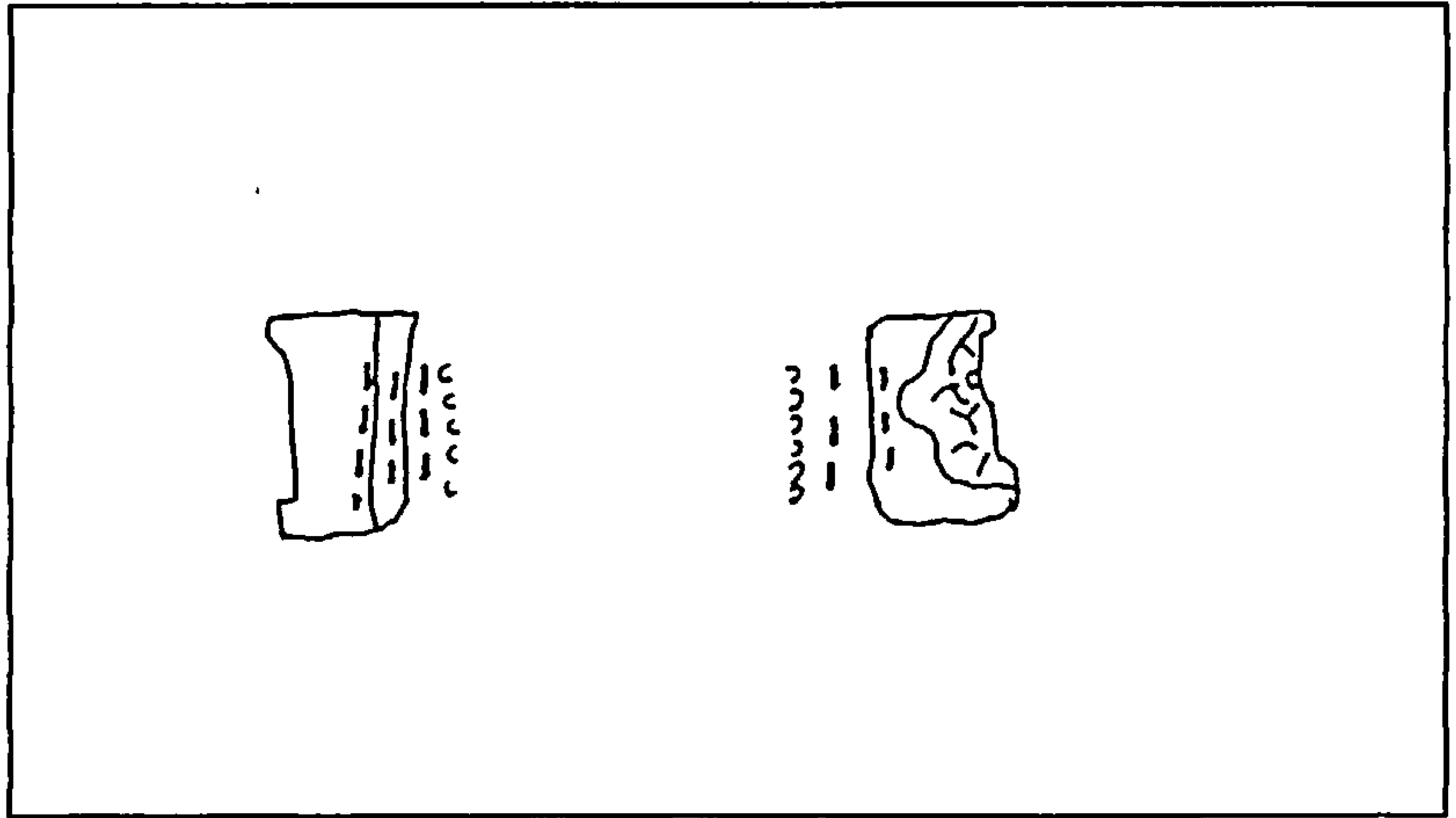
Traces:

Side b/distal, both faces virtually identical:
numerous clustered small step terminating deep
scars, associated with restricted patchy polish
along edge. Polish is smooth invasive, partially
linked, developed, with gradual edge and rare medium
irregular pits. Very shallow penetration.

Interpretation: Corner b/distal used. Longitudinal, prob
grooving, med hard mat.

Comments:

Ref: SM317
Type:
Blank: FLAKE
Mat: CHERT
Dim: 17x14x4
Qual: GOOD
Cond: FRESH



Material: Grain: M Homog: H Crys: O Topo: F Fissures:
A

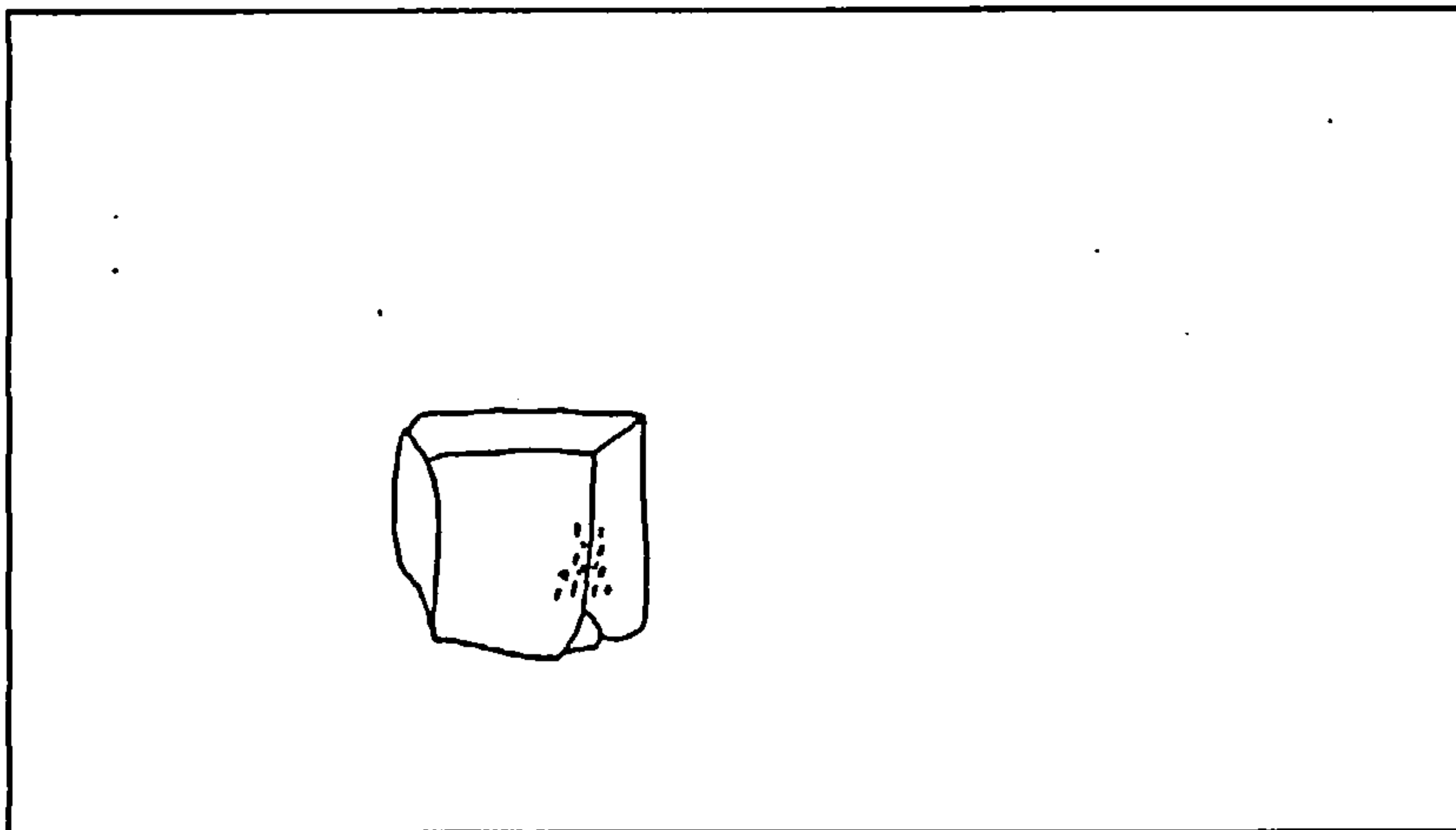
Edge Angle: thick

Traces:

Side b, both faces nearly identical: numerous to regular clustered variable step terminating deep scars with snaps associated with A: patchy spread of polish away from edge. Polish is smooth flat, allover, intense, bright, with sharp edges and no internal features. B: narrow linear features on edge and ridges parallel to edge. Polish is smooth reticulated to invasive, variable, with soft edges and no internal features. Associated with parallel long deep narrow striations.

Interpretation: Side b used, long motion, hard material?
Comments:

Ref: SM319
Type: CORE
Blank: CORE
Mat: CHERT
Dim: 29x26x18
Qual: MED
Cond: FRESH



Material: Grain: M Homog: V Crys: O Topo: F Fissures:
O

Edge Angle: thick

Traces:

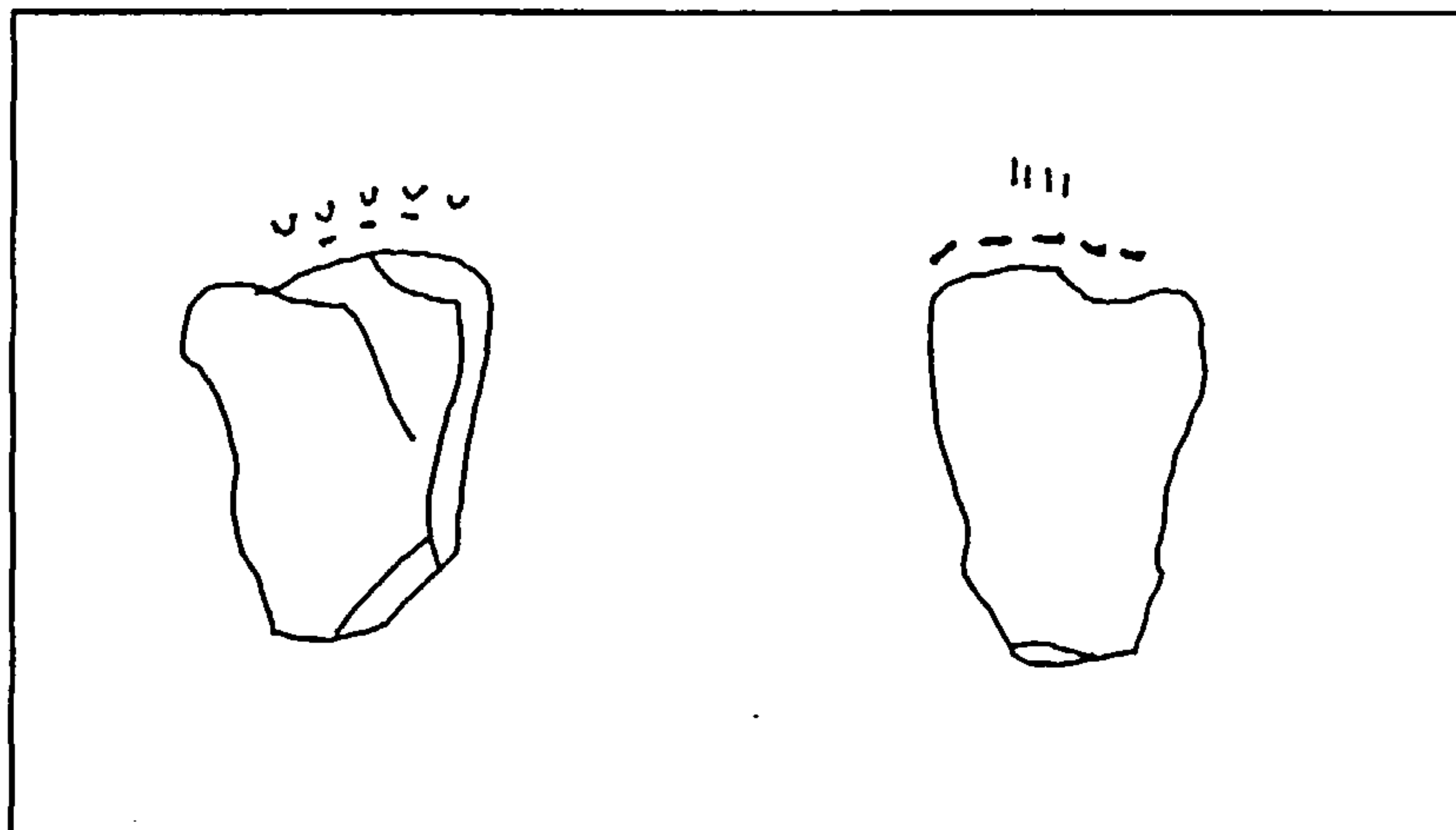
Numerous traces associated with techno work.

On face: Patchy spread of polish. Polish is smooth flat and domed allover, developed, variable, sharp edges with frequent large to medium irreg pits. Associated with extremely variable striations, tending to be parallel to ridges.

Interpretation: Core face used - grinding/polishing - not pounding

Comments:

Ref: SM322
Type:
Blank: FLAKE
Mat: CHERT
Dim: 32x28x12
Qual: MED
Cond: FRESH



Material: Grain: M Homog: H Crys: C Topo: F Fissures:
0

Edge Angle: thick

Traces:

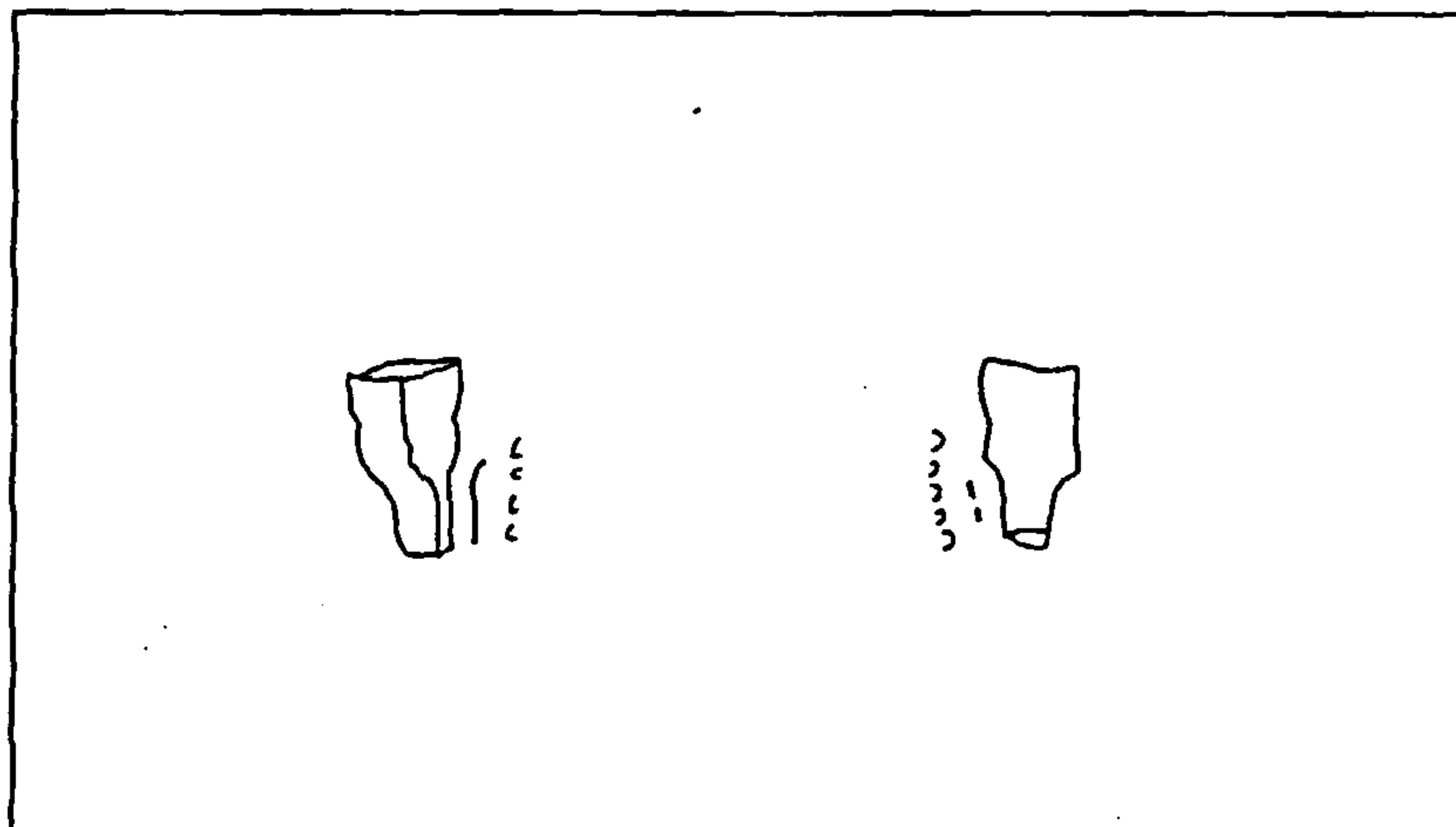
Dorsal distal: numerous clustered variable step terminating deep scars. Associated with minor patchy polish

Ventral distal: Restricted narrow linear polish along edge. Polish is rough reticulated bright, with sharp edge and no internal features. very restricted. Associated with perpendicular, short fine striations.

Interpretation: Distal end used. Transverse motion, hard material.

Comments: polish v thin and poor, only opposed edge damage indicates it results from use

Ref: SM323
Type:
Blank: BLADE
Mat: CHERT
Dim: 19x10x3
Qual: MED
Cond: FRESH



Material: Grain: M Homog: H Crys: C Topo: F Fissures:
O

Edge Angle: thick

Traces:

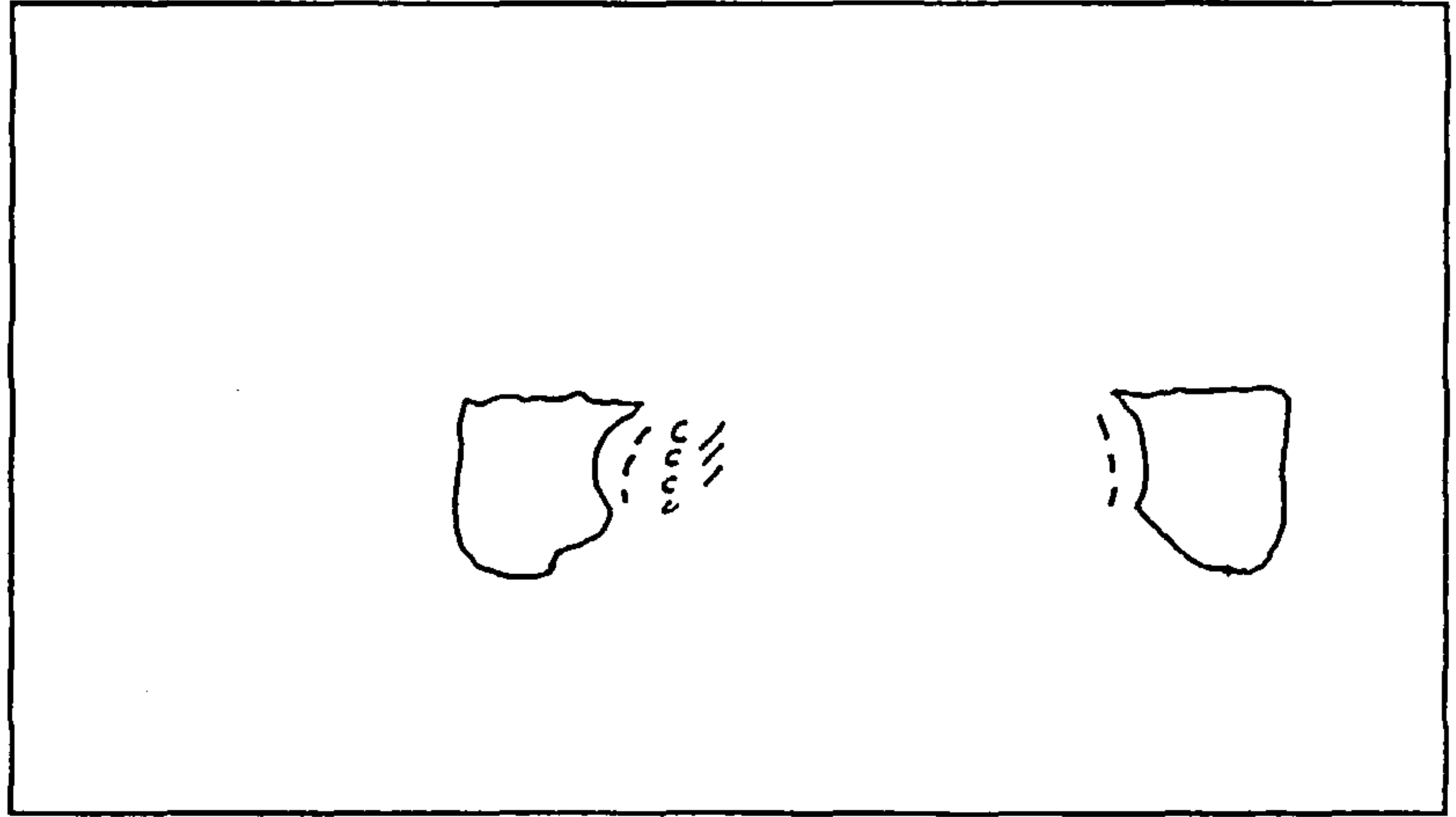
Dorsal side b: numerous clustered medium step terminating deep scars associated with narrow linear polish along edge. Polish is smooth invasive, allover, developed, with sharp edges and no internal features

Ventral side b: numerous clustered medium step terminating deep scars, associated with some gloss around scar arretes

Interpretation: side b used

Comments: minimal information, confused by bifacial edge damage and unifacial polish

Ref: SM325
Type:
Blank: FLAKE
Mat: CHERT
Dim: 17x18x4
Qual: MED
Cond: FRESH



Material: Grain: M Homog: H Crys: O Topo: F Fissures:
O

Edge Angle: medium

Traces:

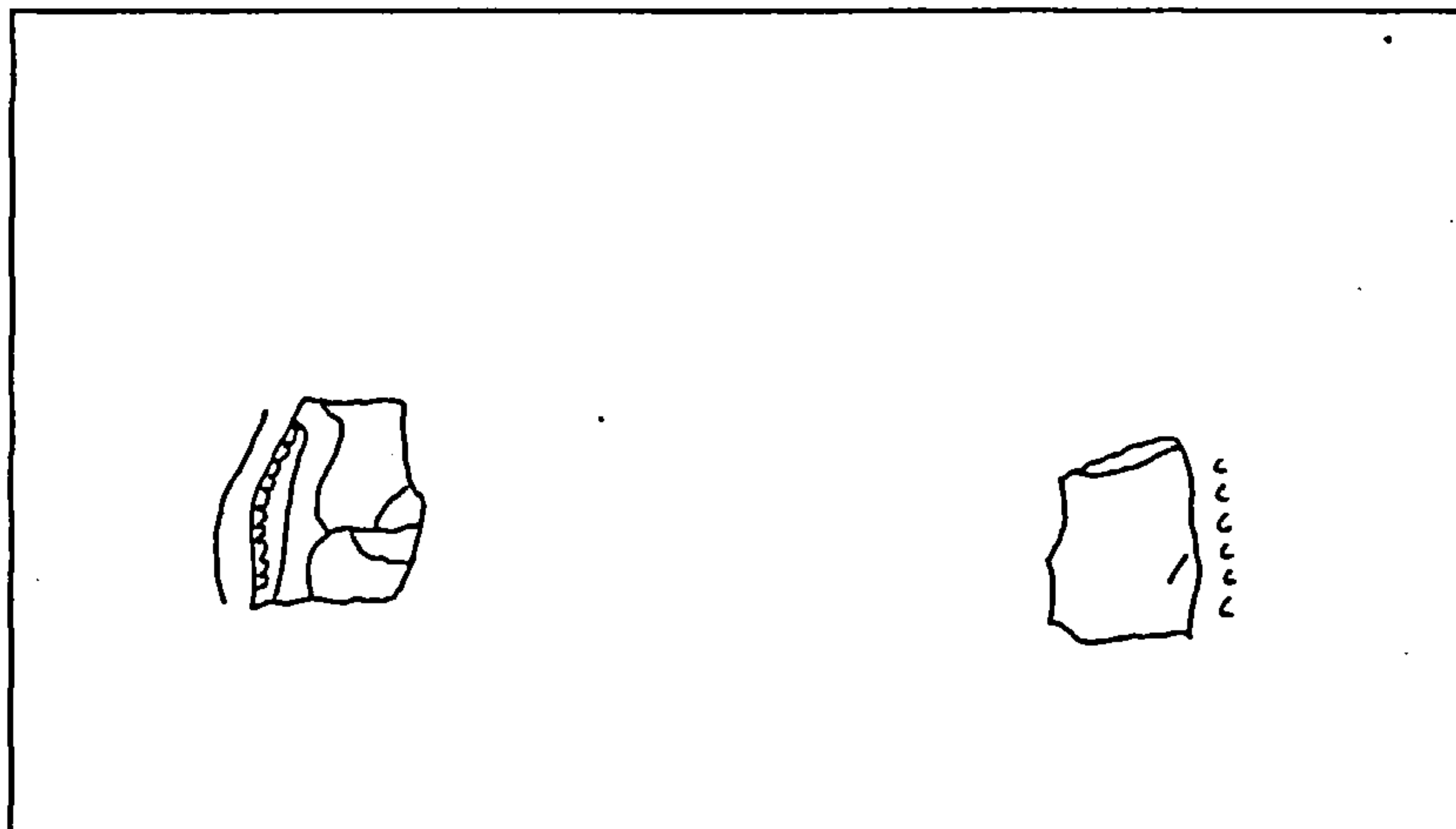
Dorsal side b: frequent clustered small feather terminating deep scars with snaps, associated with restricted patches of polish along edge. Polish is smooth reticulated (flat), partially linked, developed, with sharp edges and rare medium irregular pits and rare 45° narrow linear features. Associated with 45° short shallow wide striations

Ventral side b: No edge damage. Restricted patches of polish along edge. Polish is smooth reticulated (flat), partially linked, developed, with sharp edges and rare medium irregular pits and rare 45° narrow linear features.

Interpretation: Side b used. Transverse motion

Comments: Striations support unifacial distribution of edge damage, polish is so narrow that bifacial distribution is of little significance

Ref: SM330
Type:
Blank: FLAKE
Mat: CHERT
Dim: 22x12x7
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: thick

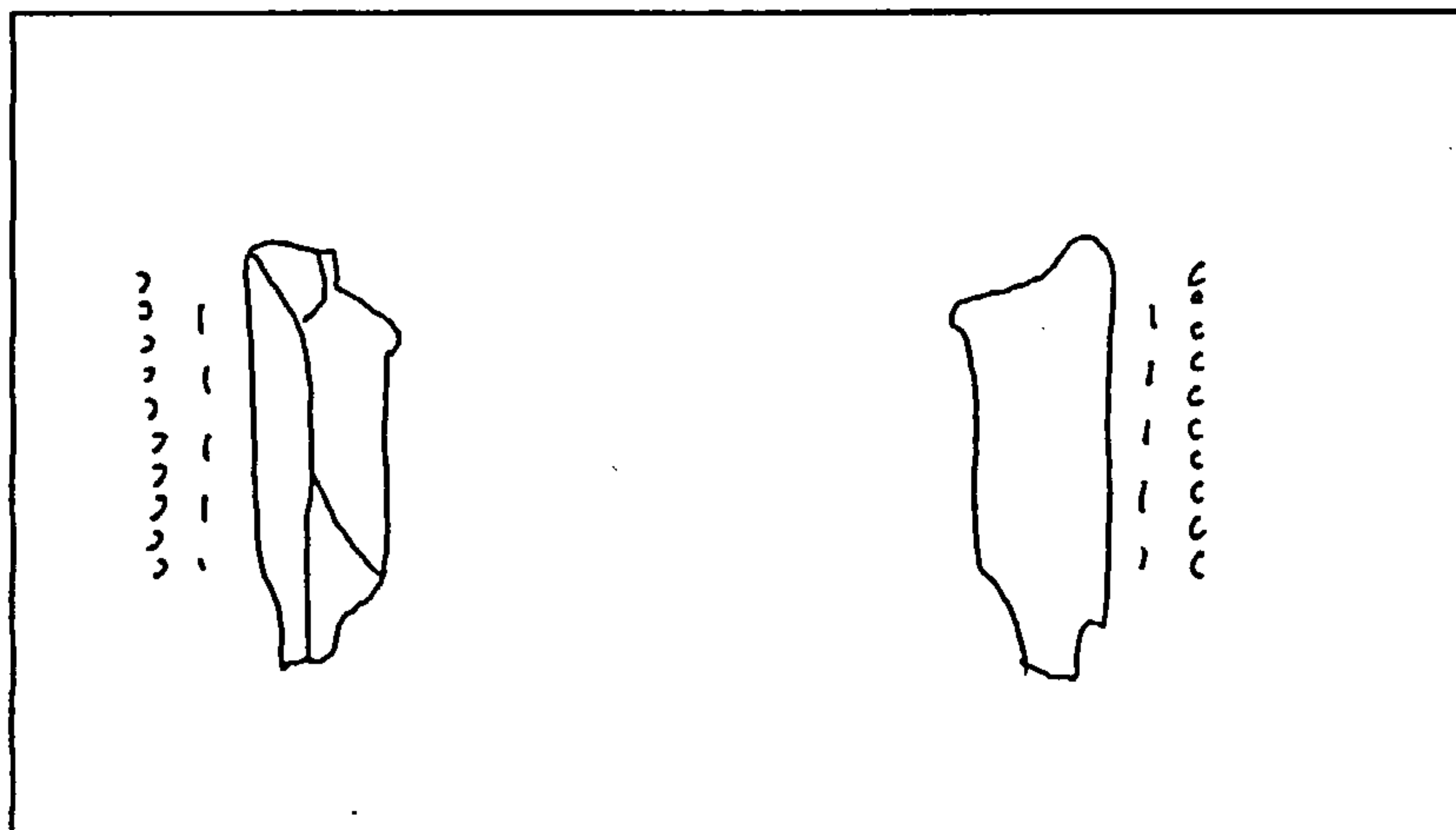
Traces:

Dorsal a: edge damage difficult to record due to retouch. Rounding associated with best developed polish. Broad spread of polish along and away from edge. polish is smooth invasive, allover, intense, bright, with fairly sharp edges and occasional medium irregular pits. Associated with short shallow broad 45° striations.

Ventral a: frequent clustered small to minute step terminating deep scars with snaps. One linear polish feature at 45° to edge

Interpretation: side a used, unifacial = transverse
Comments:

Ref: SM332
Type: ED
Blank: BLADE
Mat: CHERT
Dim: 36x12x4
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

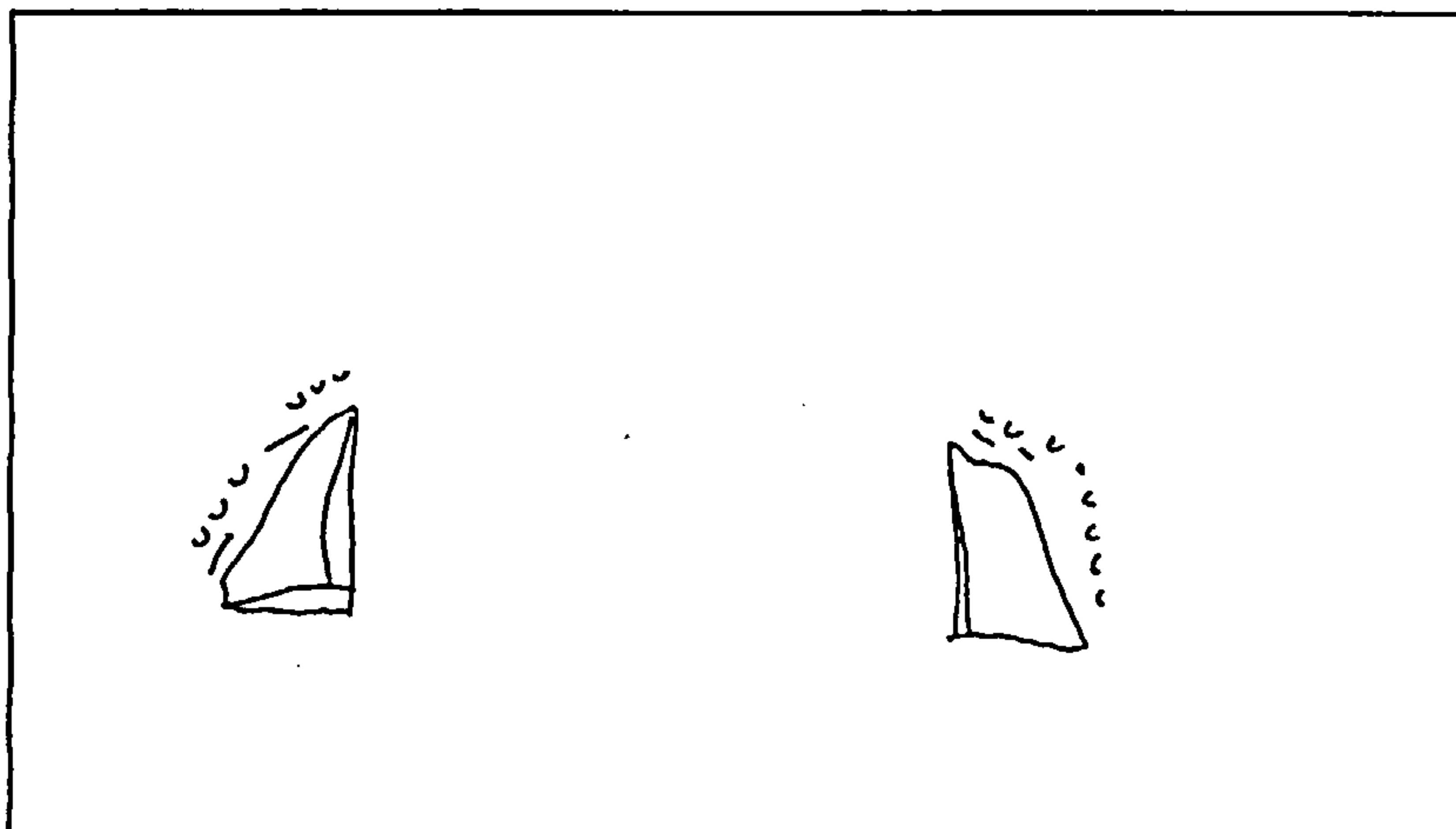
Edge Angle: medium

Traces:

Side a, both faces virtually identical: numerous clustered large step terminating deep scars, with slight rounding, associated with spread of polish along edge. Polish is smooth invasive, partially linked, developed, edge is fairly gradual, no internal features

Interpretation: Side a used, long motion
Comments:

Ref: SM334
Type: ED
Blank: FLAKE
Mat: CHERT
Dim: 17x13x7
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: C Topo: F Fissures:
A

Edge Angle: medium

Traces:

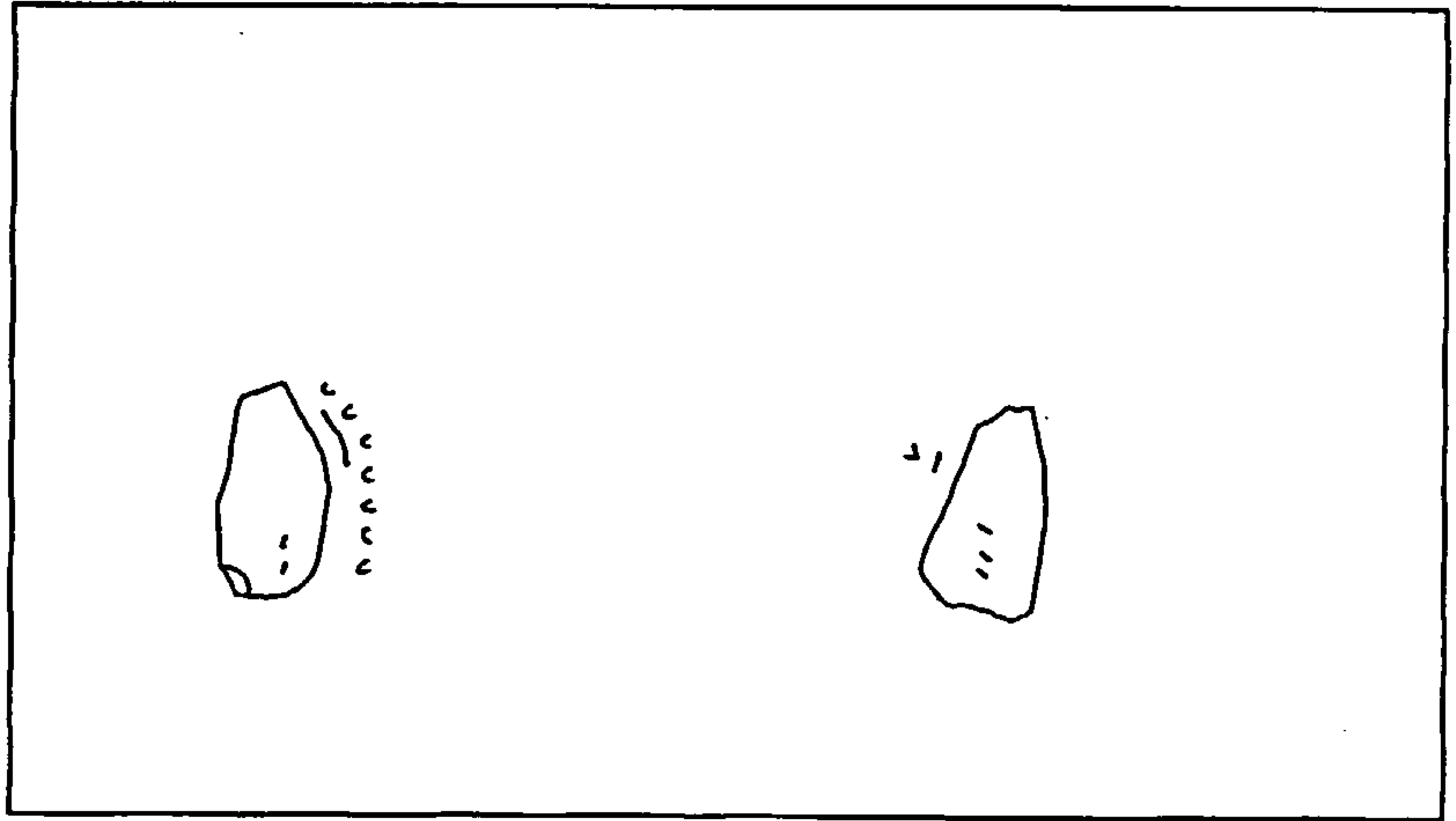
Dorsal a: occasional clustered small to minute feather terminating deep scars with snaps, associated with patchy spread of polish along and away from edge. Polish is smooth invasive (some linearity parallel to edge), developed, partially linked, variable, with sharp edges and occasional small irregular pits. Associated with perpendicular short shallow medium scattered striations

Ventral a: Frequent clustered large to small feather terminating deep scars associated with restricted narrow linear polish along edge. Polish is smooth reticulated, scattered, poor.

Interpretation: Side a used, concentrated near tip.

Comments: General trend suggests unifacial = transverse use, but polish pattern suggests longitudinal grooving use.

Ref: SM336
Type:
Blank: FLAKE
Mat: CHERT
Dim: 19x11x3
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: medium

Traces:

Dorsal b: numerous clustered large to small step
terminating deep scars.

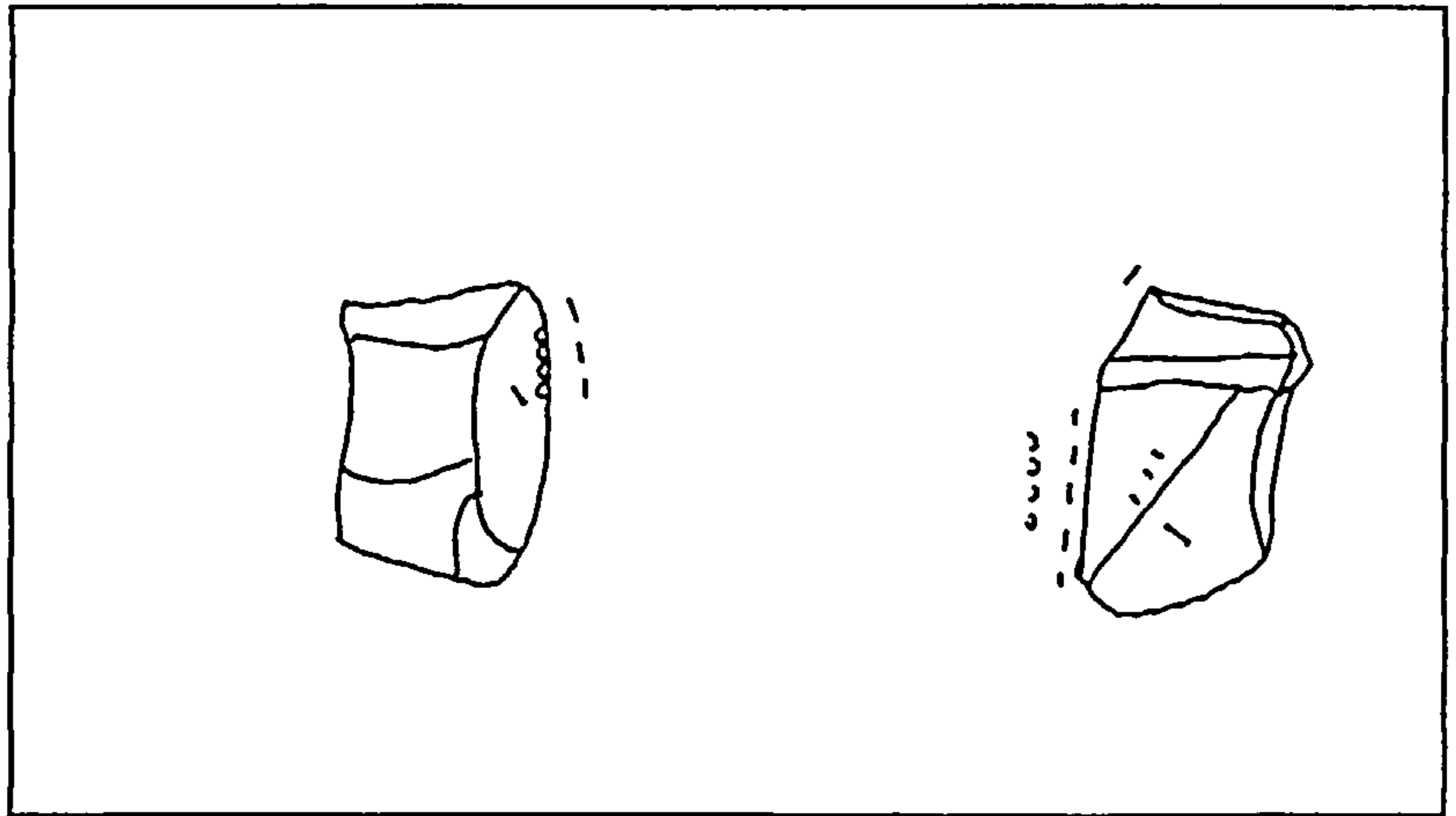
Ventral b: some snaps associated with scars on
dorsal, associated with v restricted narrow linear
polish along edge. Polish is smooth flat, developed,
allover, with sharp edges and frequent minute
circular pits.

Dorsal and ventral surfaces have numerous scattered,
mostly poor, polish features

Interpretation: side b used, prob transverse

Comments: problems caused by clear NUW from PDSM

Ref: SM344
Type:
Blank: FLAKE
Mat: CHERT
Dim: 26x20x12
Qual: MEDIUM
Cond: FRESH



Material: Grain: M Homog: V Crys: O Topo: F Fissures:
A

Edge Angle: thick

Traces:

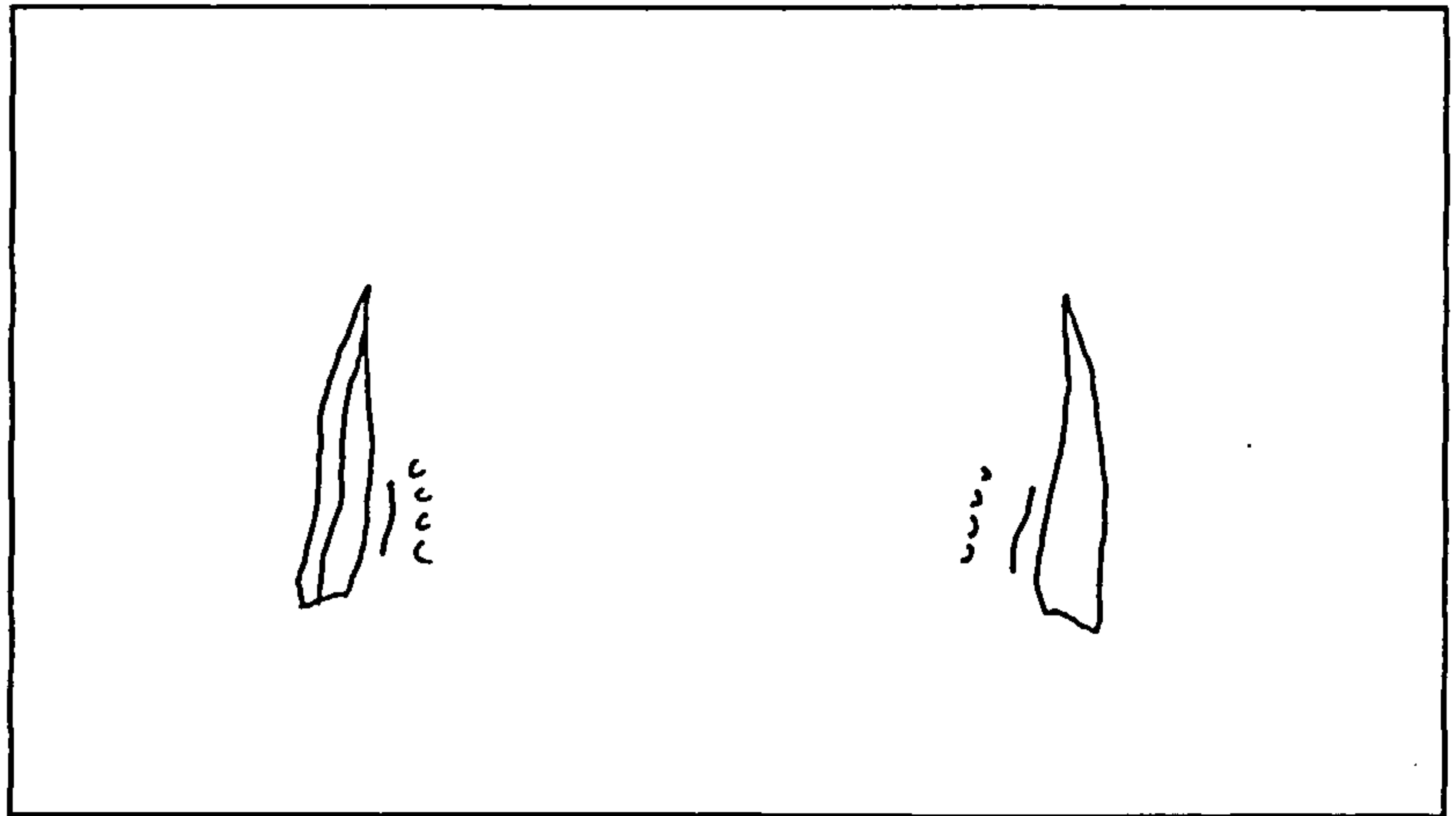
Dorsal side b: no edge damage. Polish is restricted along edge, smooth domed, partially linked, developed, edges fairly gradual with frequent minute circular pits.

Ventral side b: Occasional clustered large step terminating deep scars. Associated with restricted polish along edge, smooth domed, partially linked, developed, edges fairly gradual with frequent minute circular pits.

Interpretation: side b used, probably transverse motion, hard material

Comments:

Ref: SM348
Type:
Blank: BLADE
Mat: FLINT
Dim: 24x3x
Qual: GOOD
Cond: SP



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

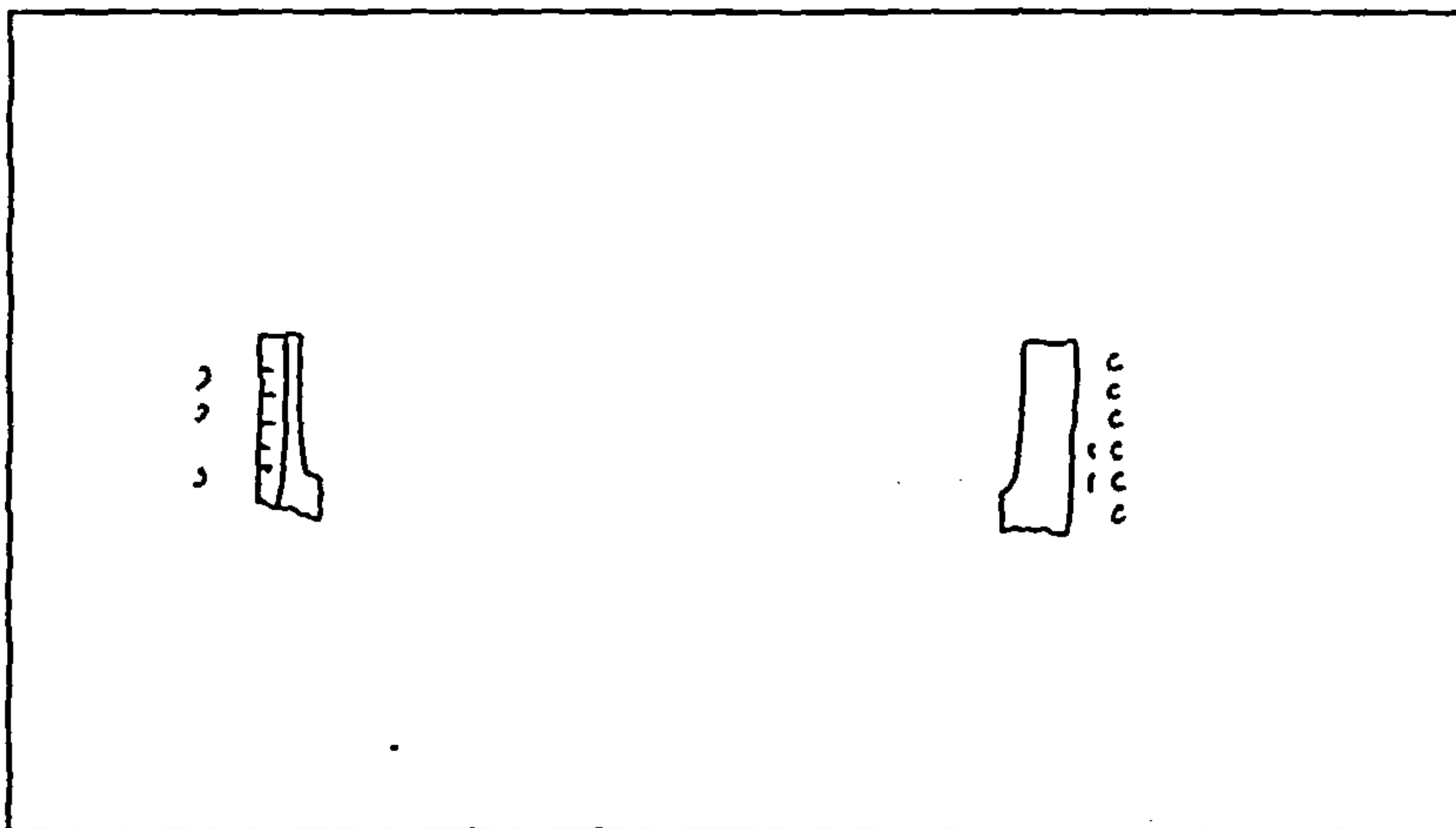
Edge Angle: thick

Traces:

Side b, both faces virtually identical: Occasional clustered medium to small mixed terminating deep scars associated with patches of polish along edge. Polish is smooth domed (reticulated), partially linked, variable, gradual edges with no internal features

Interpretation: Side b used, long motion, shallow penetration, soft/medium soft material
Comments:

Ref: SM349
Type:
Blank: BLADE
Mat: CHERT
Dim: 14x5x
Qual: GOOD
Cond: FRESH



Material: Grain: M Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: thick

Traces:

Dorsal side a: occasional scattered large deep step terminating scars with snaps, associated with poor ret polish and perpendicular poor narrow linear polish features.

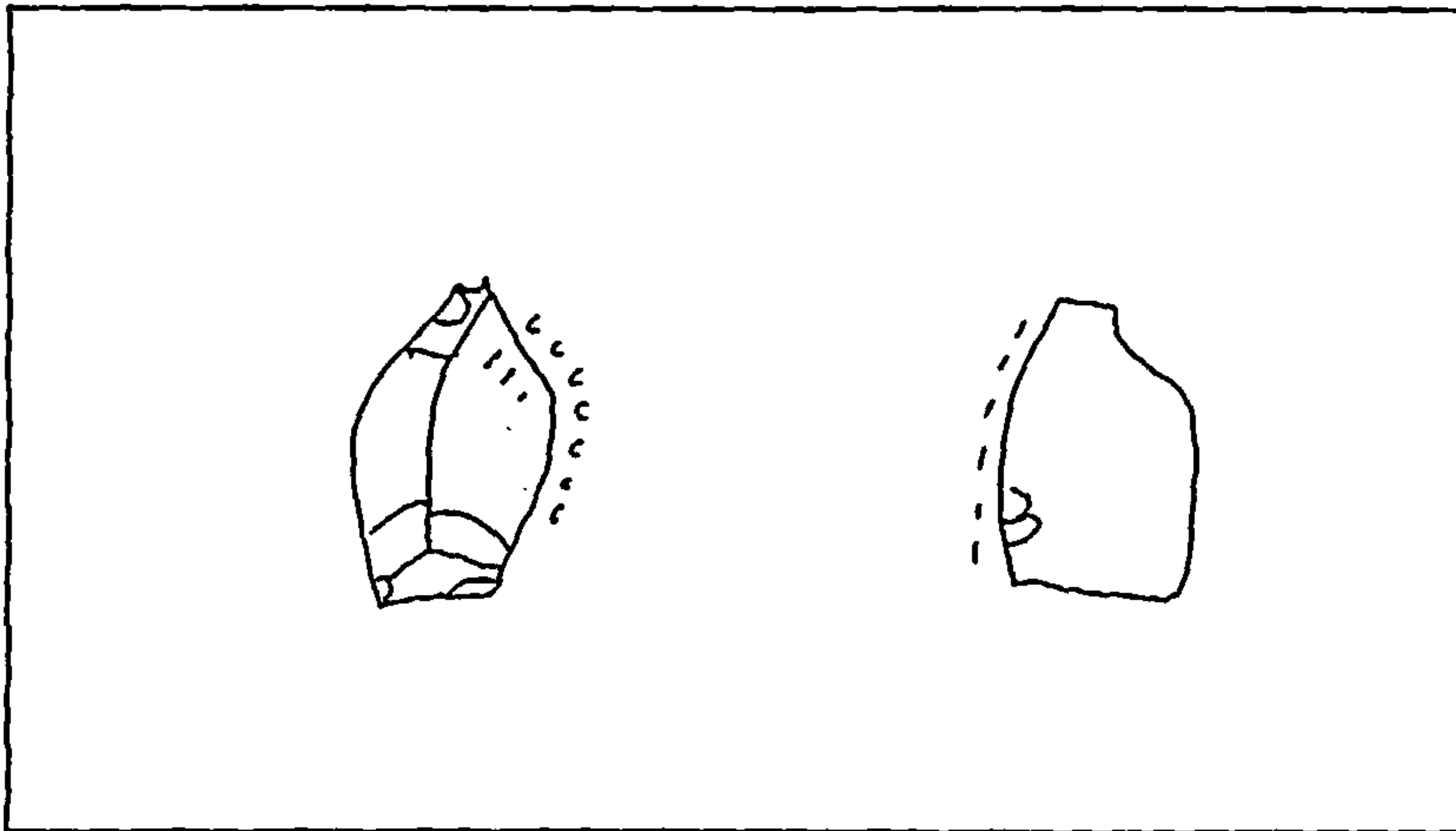
Ventral side a: numerous clustered large to medium mostly step terminating deep scars, associated with patchy reticulated polish.

Dorsal ridge, near proximal end: Smooth patchy polish with striations perpendicular to edge

Interpretation: side a used. Prob transverse, probably hard material

Comments: distal end possibly snapped off during use. Polish on dorsal ridge possibly hafting. Rather poor traces altogether.

Ref: SM350
Type:
Blank: FLAKE
Mat: CHERT
Dim: 22x18x
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: medium

Traces:

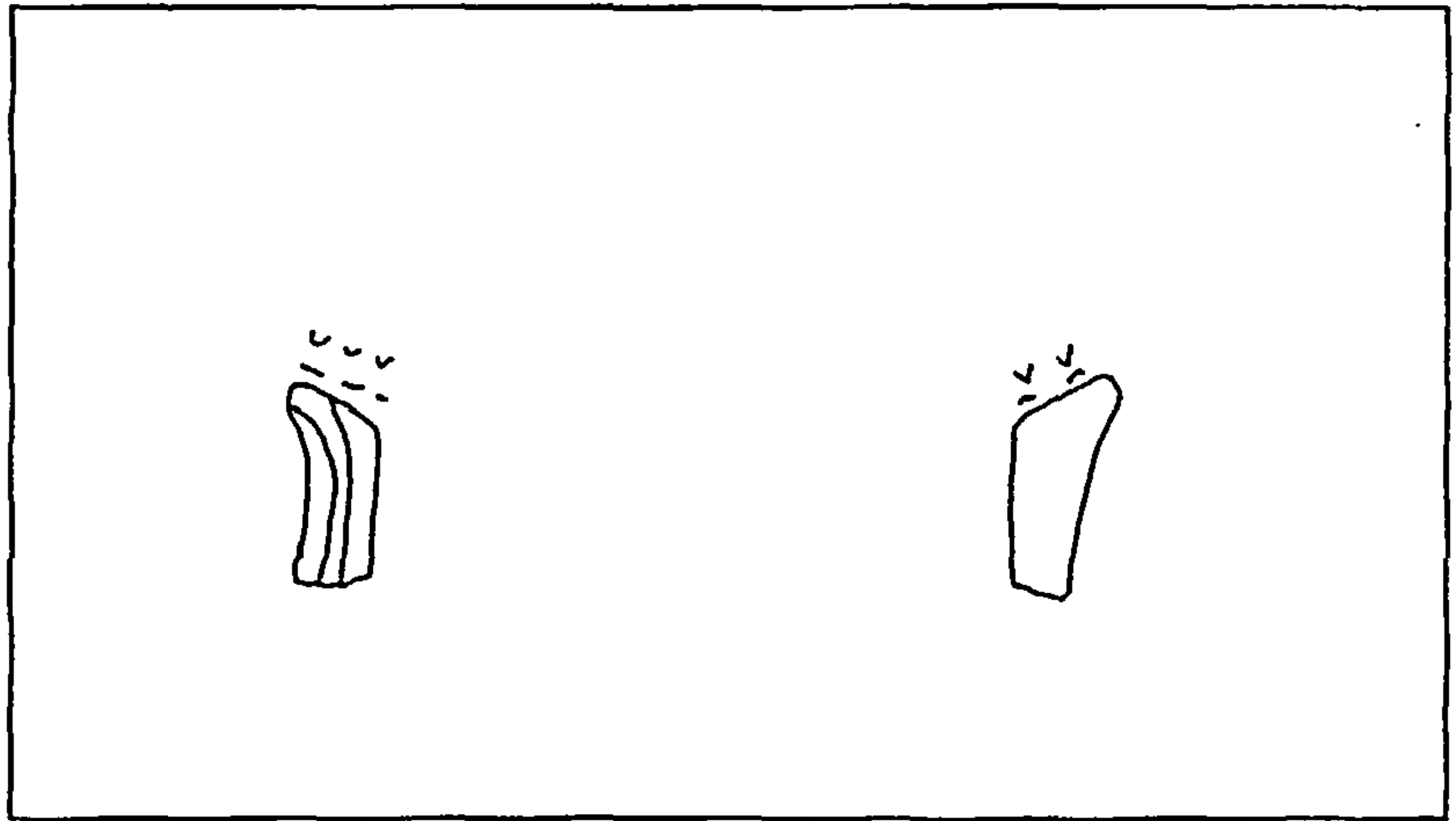
Dorsal side b: numerous clustered medium to large mostly step terminating deep scars, associated with narrow linear polish feature, several bands at 45° to edge.

Ventral side b: Minor edge damage, associated with patchy polish along edge. Polish is smooth flat, allover, intense, variable, with common small circular pits.

Interpretation: Side b used, transverse, heavy use, hard material (ie bone/antler)

Comments:

Ref: SM351
Type:
Blank: BLADE
Mat: CHERT
Dim:
Qual: GOOD
Cond: SW



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: thick

Traces:

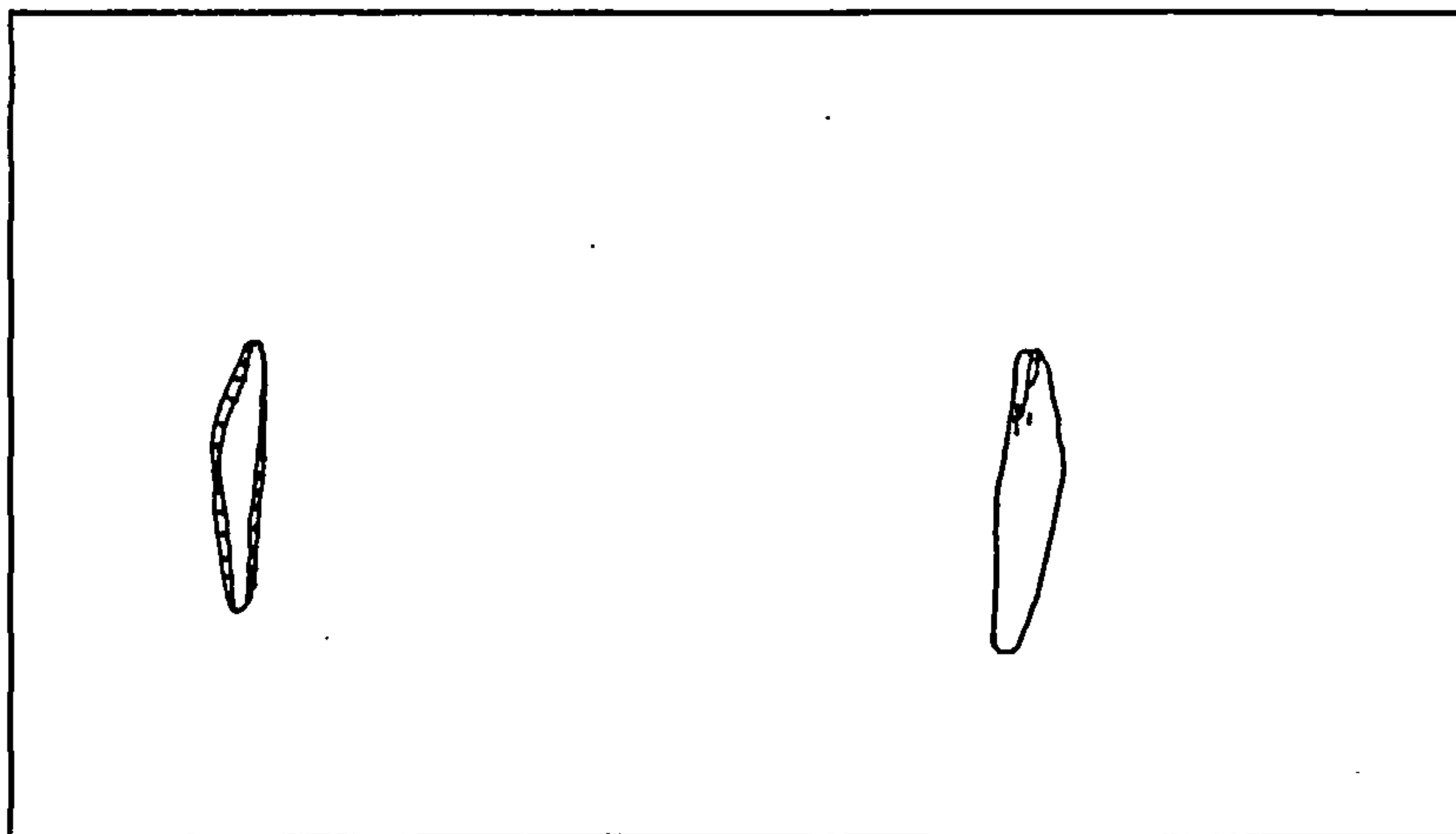
Dorsal distal: Frequent clustered medium mostly step terminating deep scars associated with patchy polish along edge. Polish is rough invasive, partially linked, variable, with gradual edges and occasional small circular pits.

Ventral distal: snap fractures and slight rounding associated with patchy polish along edge. Polish is rough invasive, partially linked, variable, with gradual edges and occasional small circular pits.

Interpretation: distal used, long motion, shallow penetration, pos grooving, med hard material

Comments: problems with NUW features

Ref: SM355
Type: MICRO
Blank: BLADE
Mat: FLINT
Dim:
Qual: MED
Cond: FRESH



Material: Grain: M Homog: H Crys: O Topo: F Fissures: A

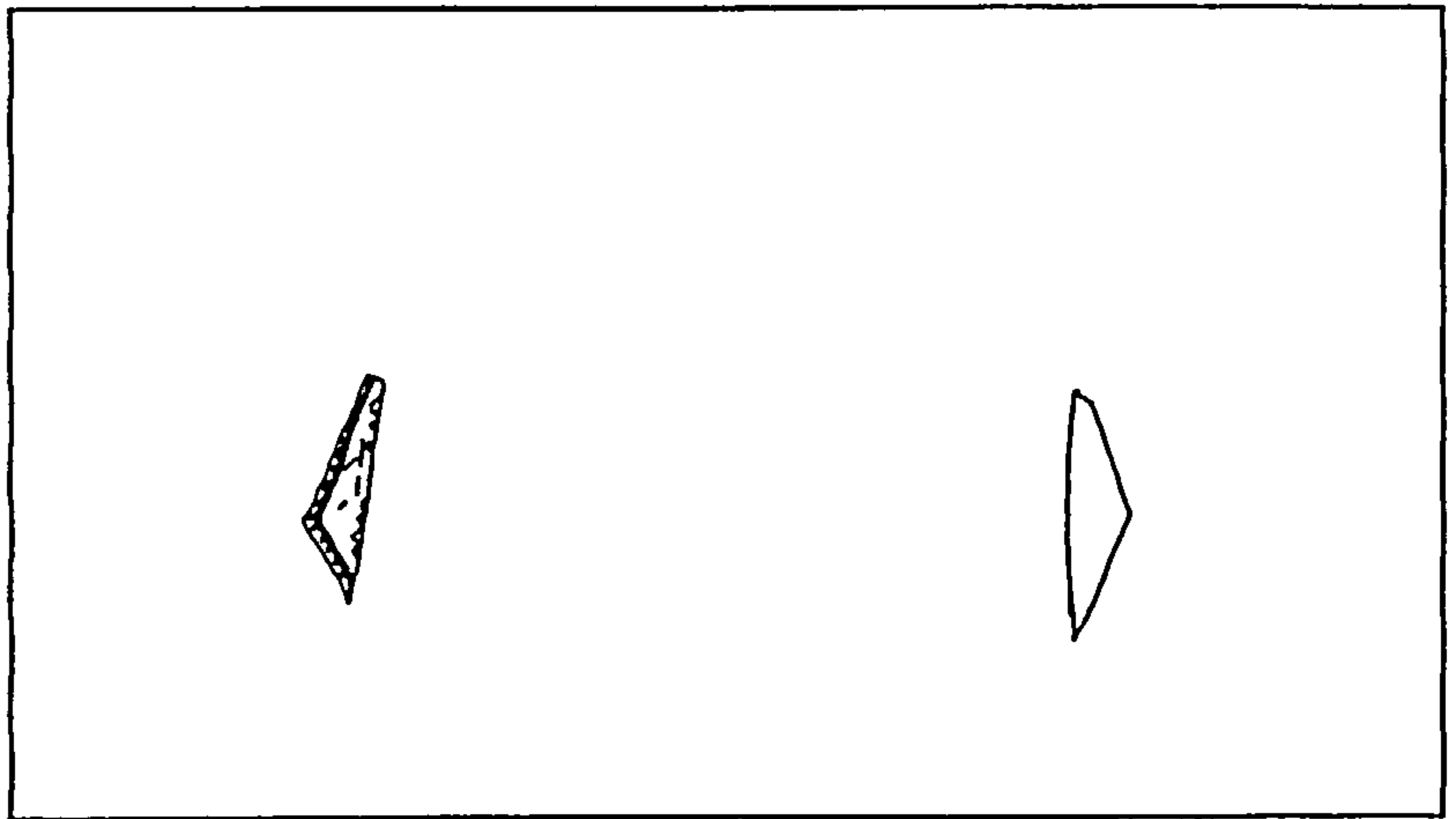
Edge Angle: point

Traces:

shallow feather terminating fractures initiated at tip. Associated with linear polish parallel to long axis of tool. Polish is smooth reticulated, partially linked, with sharp edges and no internal features.

Interpretation: used, projectile
Comments:

Ref: SM357
Type: MICRO
Blank: BLADE
Mat: CHERT
Dim:
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures: A

Edge Angle: thick

Traces:

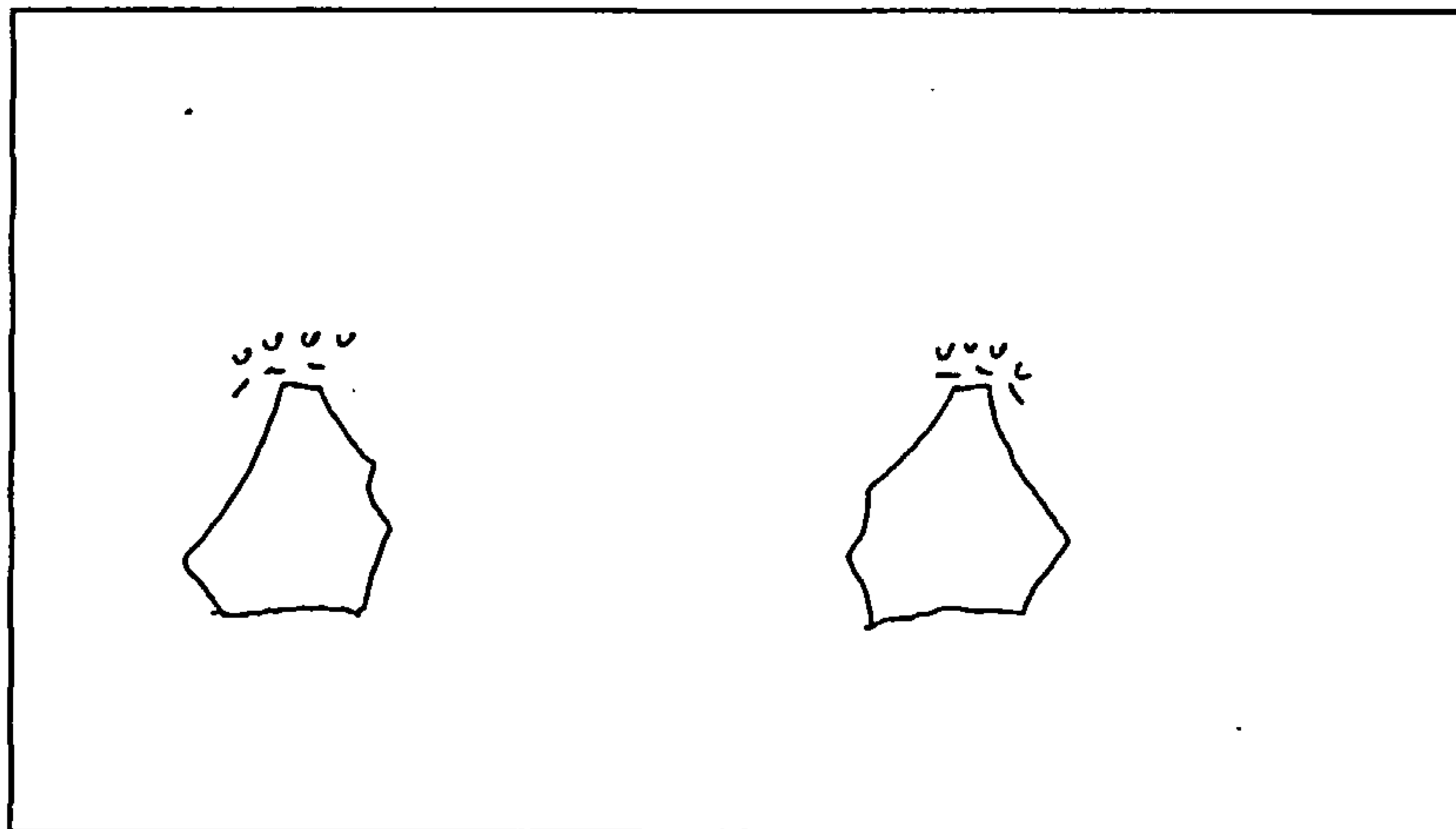
Edge damage very difficult due to retouch.

Dorsal face: Linear polish features parallel and at 45o to edge, all away from edge or on interior face. Polish is smooth reticulated, partially linked, sharp to fairly sharp edges with no internal features.

Interpretation: used, projectile use.

Comments: linear polish runs over retouch, which "cuts" the linearity, although polish clearly post-dates retouch. 45o wear acceptable as projectile turning in target

Ref: SM359
Type:
Blank: FLAKE
Mat: CHERT
Dim: 13x12x
Qual: GOOD
Cond: FRESH



Material: Grain: M Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: acute

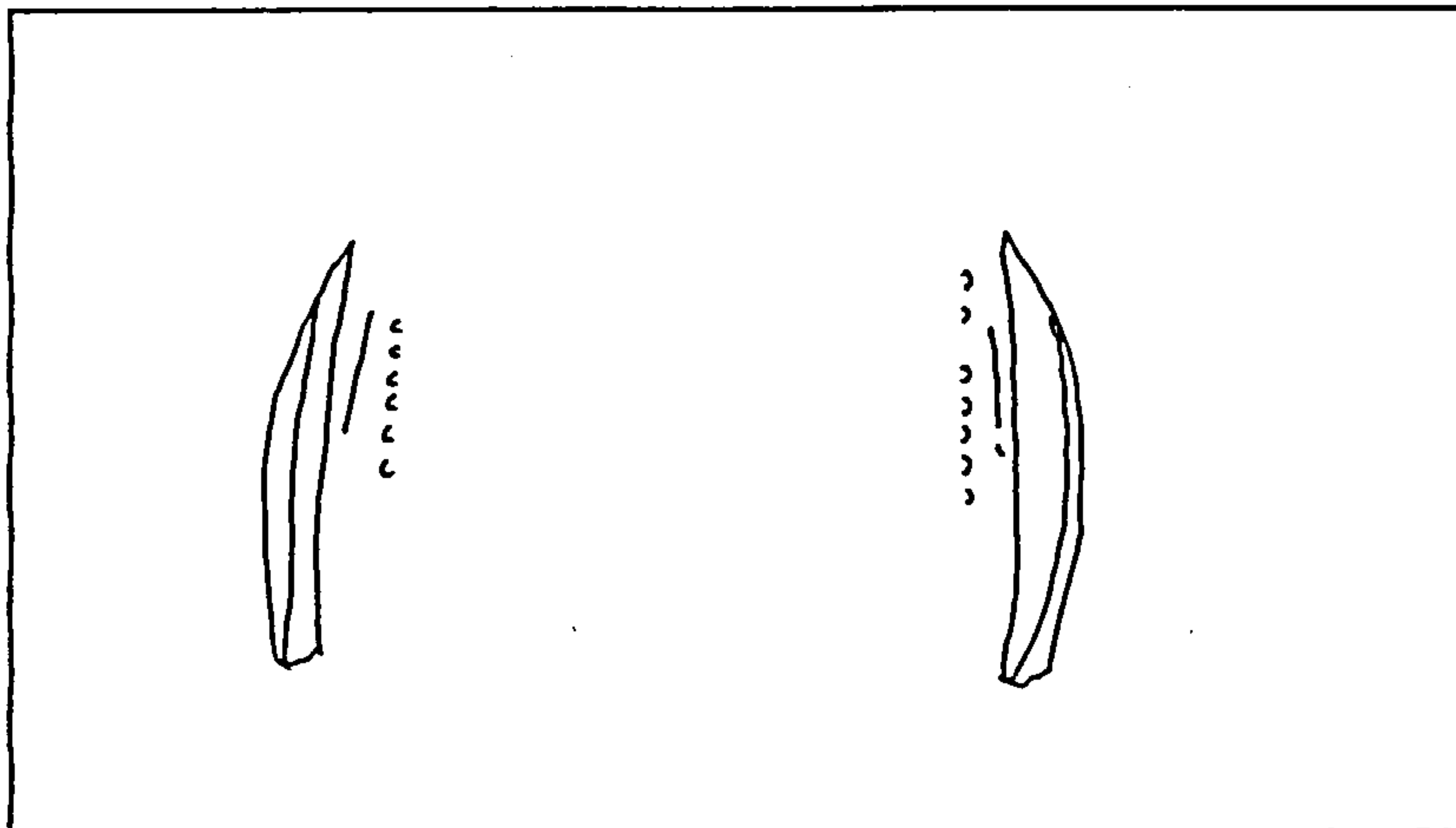
Traces:

Dorsal Distal: numerous snap fractures associated with restricted narrow linear polish along or adjacent to edge.

Ventral distal: Common step fractures, associated with restricted narrow linear polish along edge. Polish is smooth domed, intense with numerous small circular pits

Interpretation: Distal used
Comments: little detail observed

Ref: SM360
Type:
Blank: BLADE
Mat: CHERT
Dim: 29x4x
Qual: MED
Cond: FRESH



Material: Grain: M Homog: V Crys: O Topo: F Fissures:
O

Edge Angle: thick

Traces:

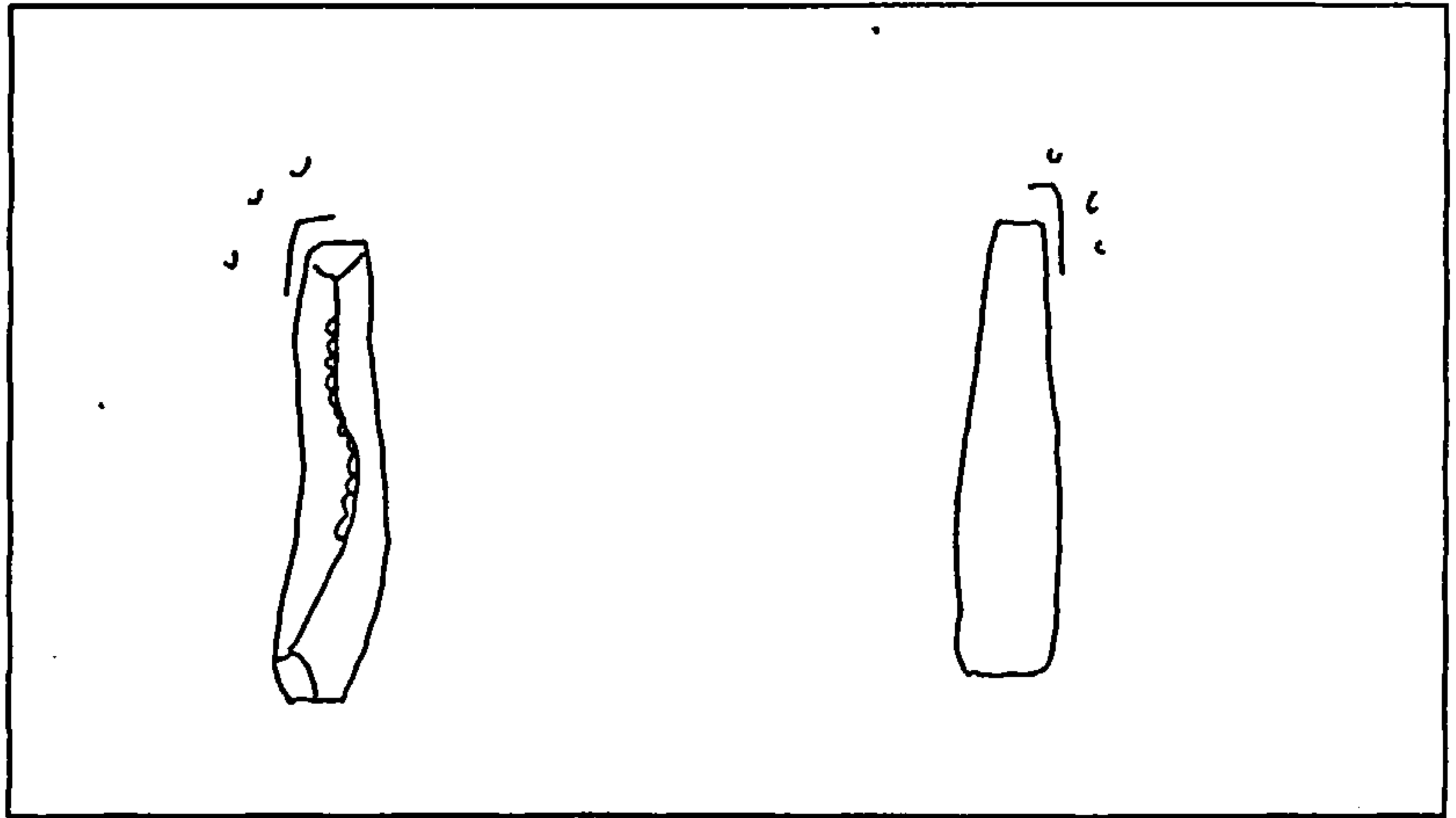
Dorsal side b: frequent clustered small step
terminating scars associated with very thin band of
polish along edge, and very thin linear features
perpendicular to edge, all poorly developed rough
reticulated scattered polish

Ventral side b: frequent clustered small step
terminating scars associated with very thin band of
polish along edge, poorly developed rough
reticulated polish

Interpretation: Pos side b used (long motion)

Comments: Unclear, minor polish traces, opp/marginal

Ref: SM361
Type:
Blank: BLADE
Mat: CHERT
Dim: 39x10x
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
O

Edge Angle: thick

Traces:

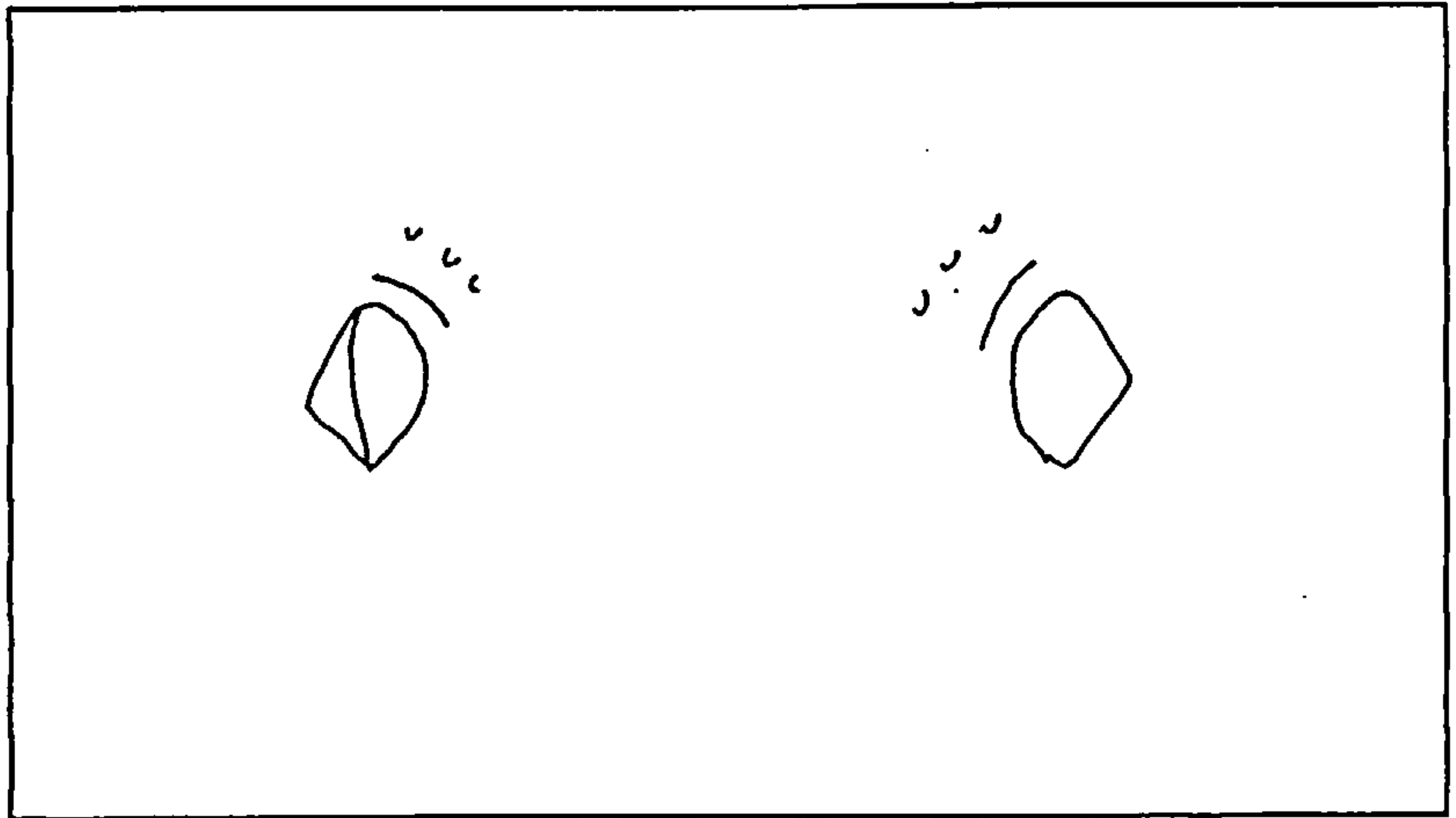
Dorsal side a and ventral side a at distal corner are identical: occasional scattered small step terminating deep scars associated with a smooth polish, developed, variable, gradual edges, following tool contours, with med to large irregular pits. Invasive into flake scars

Very complex traces over the rest of the tool, including developed polishes and striations, but no edge damage. Cannot be interpreted as use.

Interpretation: Corner of side a and distal end used, long motion, rest of numerous traces probably hafting

Comments: very complex piece, hafting the explanation by default

Ref: SM362
Type:
Blank: FLAKE
Mat: FLINT
Dim: 15x10x
Qual: MED
Cond: FRESH



Material: Grain: M Homog: V Crys: O Topo: F Fissures:
A

Edge Angle: acute

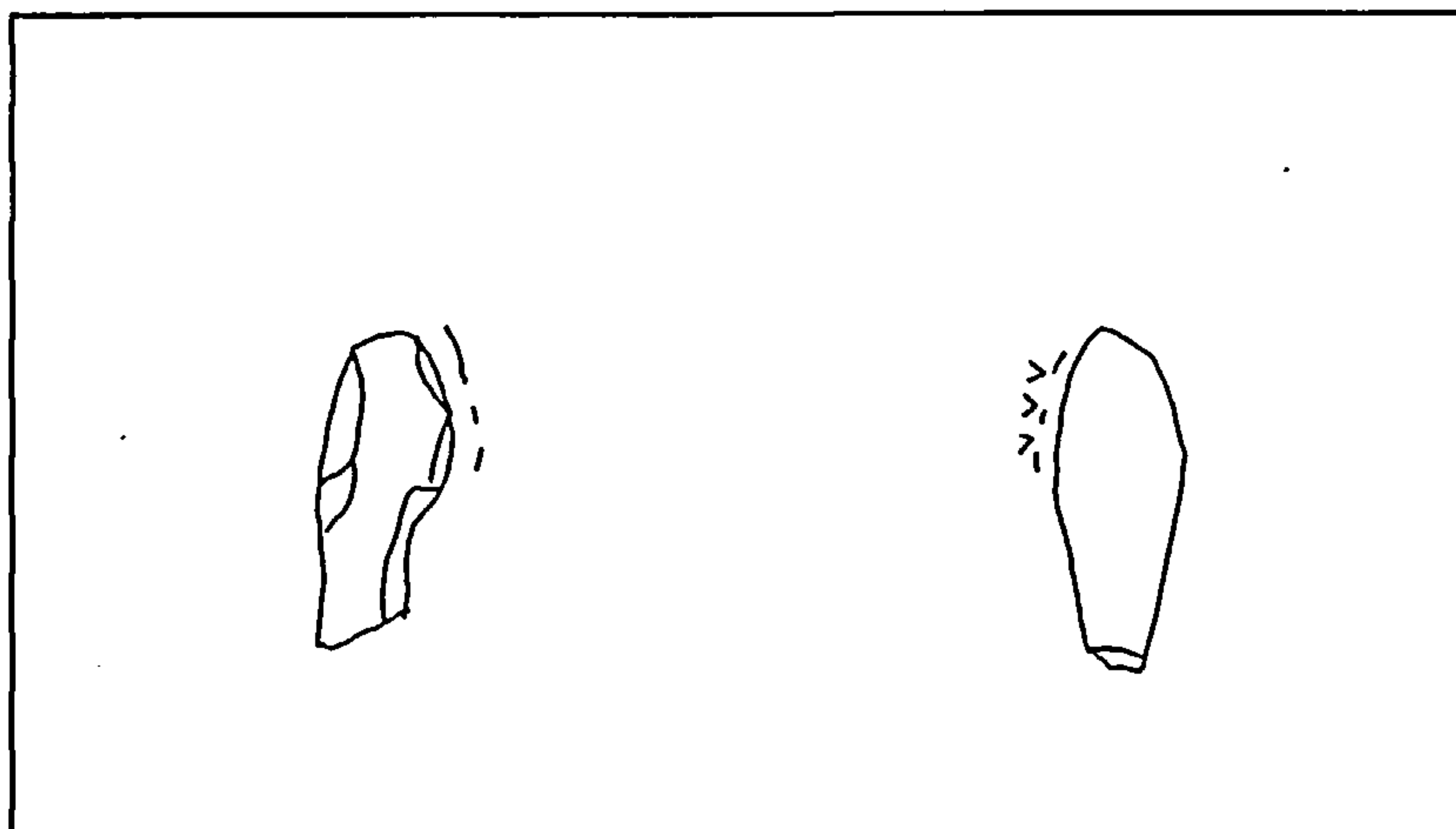
Traces:

Side b: very similar on both faces: minor edge damage, associated with a restricted narrow linear polish along the edge, polish is smooth reticulated, developed, scattered.

Interpretation: side a used, long motion, prob hard material, light work

Comments: hard material diagnosis from polish despite lack of edge damage, tend to find such polish only with hard materials, edge damage not caused as work is light.

Ref: SM363
Type:
Blank: BLADE
Mat: CHERT
Dim: 20x8x
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
O

Edge Angle: acute

Traces:

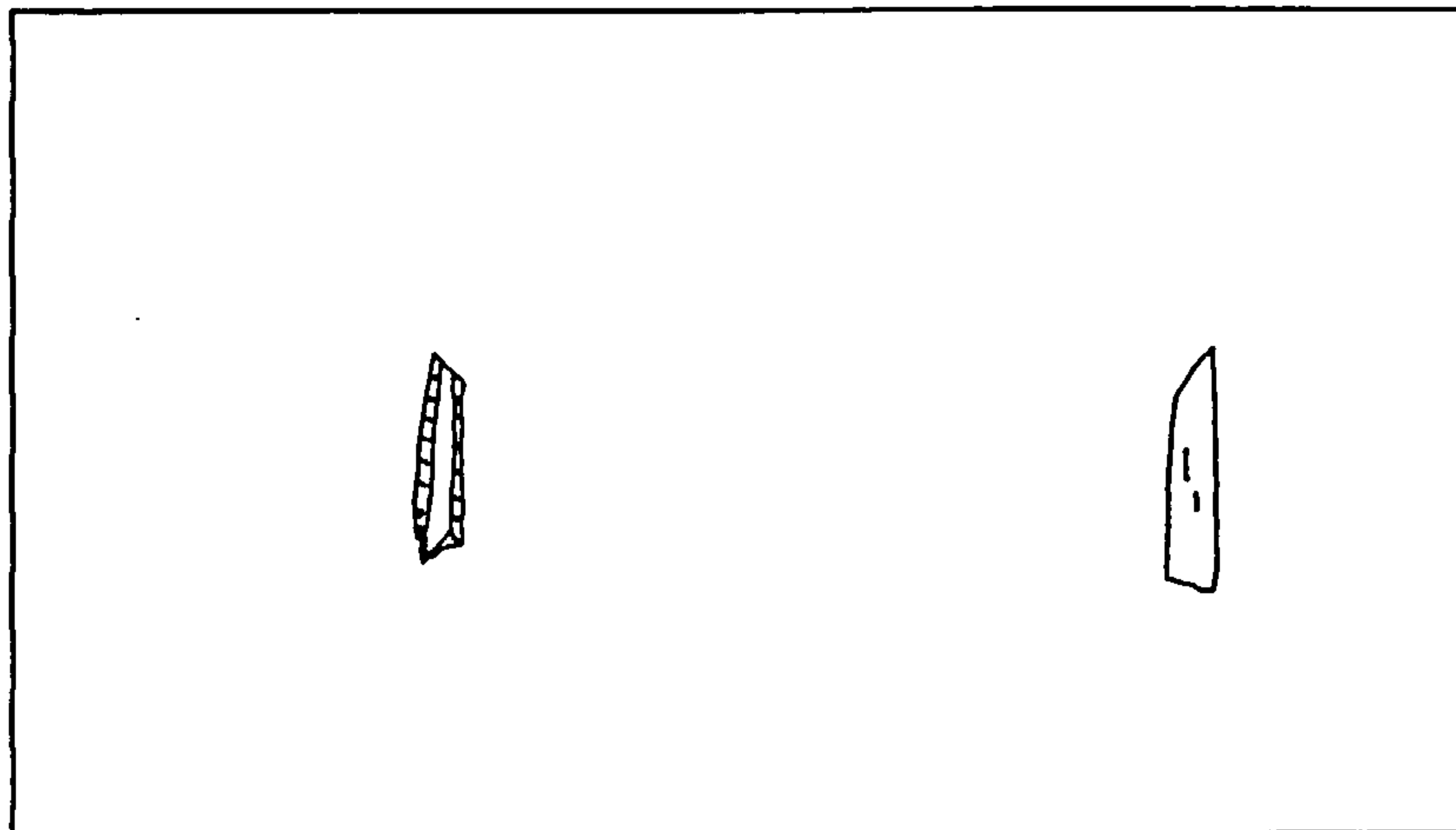
Dorsal side b: no edge damage, restricted patchy
polish. Polish is smooth reticulated, developed.
Also linear polish along edges and ridges

Ventral side b: snapped edge, associated with very
patchy spread of smooth domed polish. No associated
features.

Interpretation: side b light use

Comments: NUW features cause problems in identification

Ref: SM364
Type: MICRO
Blank: BLADE
Mat: CHERT
Dim:
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: A Crys: A Topo: F Fissures: A
Edge Angle: thick

Traces:

Edge damage not recorded due to retouch scarring

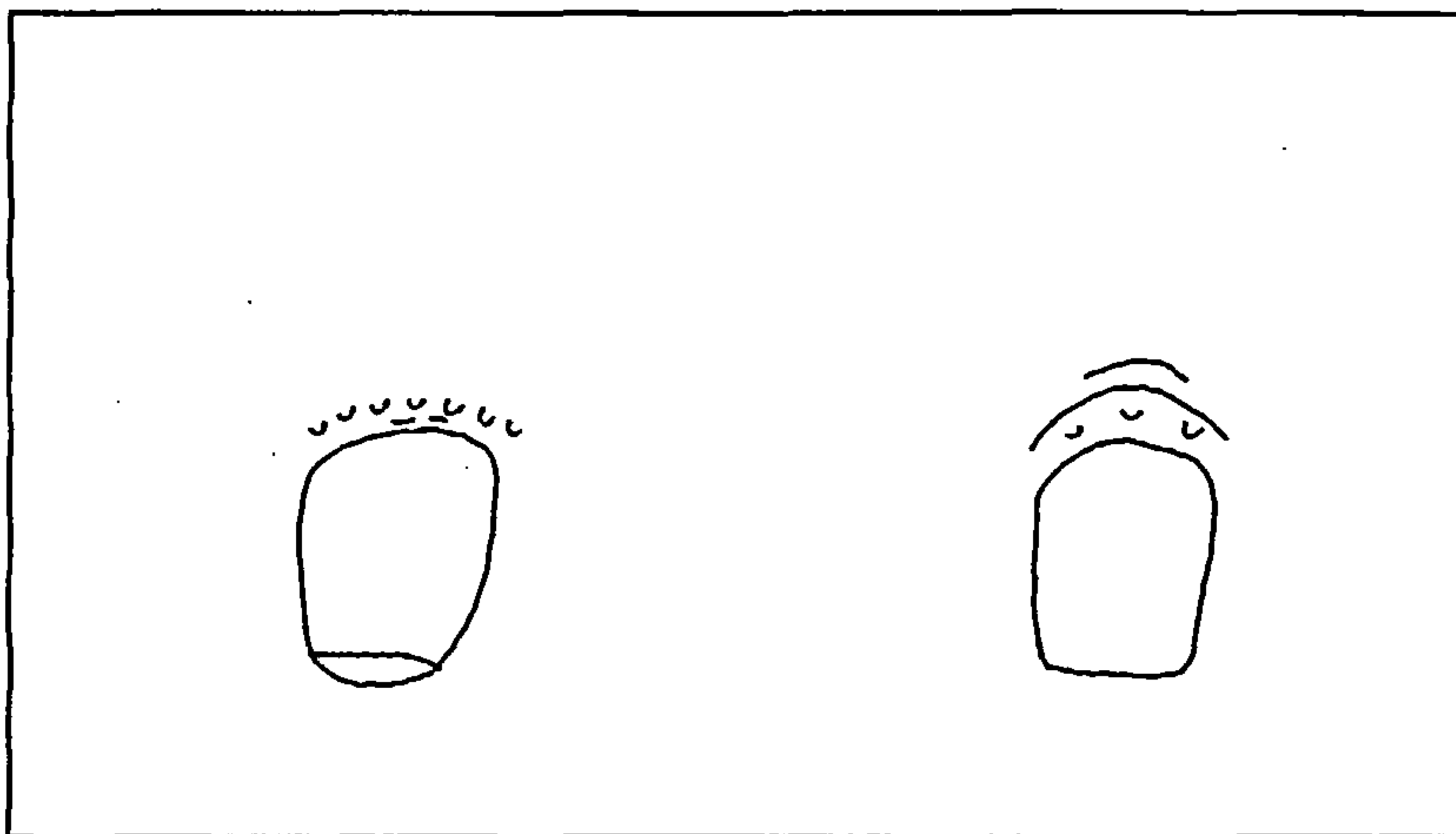
Ventral face: several linear polish features running parallel to long axis of piece. Polish is smooth reticulated, partially linked, with sharp edges and no internal features.

Separate polish associated with retouch platforms

Interpretation: pos used, projectile

Comments: not very clear, no supporting evidence

Ref: SM365
Type:
Blank: FLAKE
Mat: CHERT
Dim: 16x14x
Qual: POOR
Cond: FRESH



Material: Grain: C Homog: V Crys: C Topo: R Fissures:
O

Edge Angle: acute

Traces:

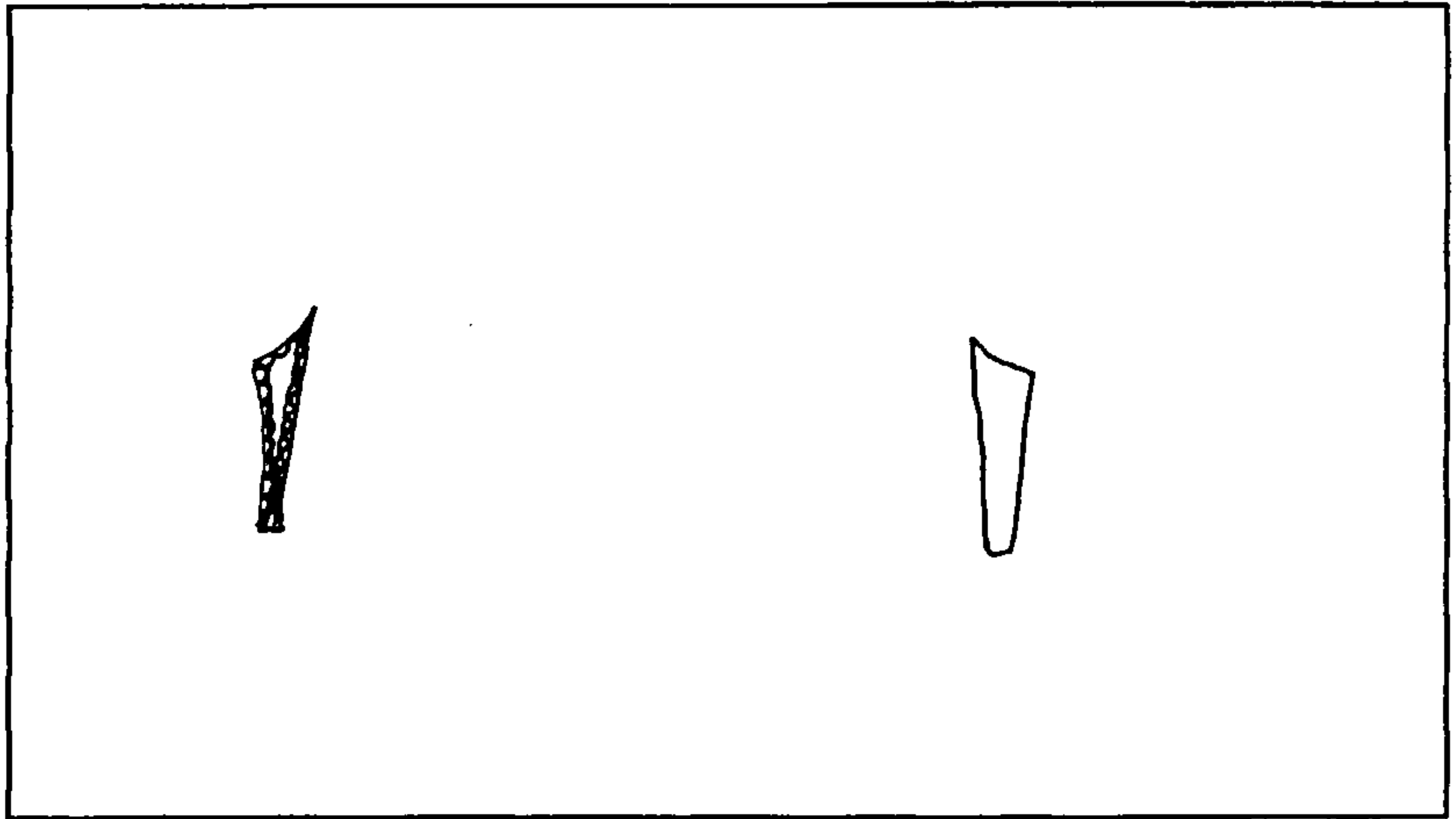
Dorsal distal and b: common clustered medium mostly step terminating deep scars, associated with small patches of polish on edge. Polish is developed, reticulated.

Ventral distal and b: occasional scattered minute mostly step terminating deep scars associated with patchy spread of polish along edge and away from edge. Polish is reticulated, developed, variable with gradual edges.

Interpretation: Distal used, probably transverse, prob hard material

Comments: crystals and generally rough surface make examination difficult. Reticulation probably not entirely the product of coarse surface texture.

Ref: SM369
Type: MICRO
Blank: BLADE
Mat: CHERT
Dim:
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures: A

Edge Angle: thick

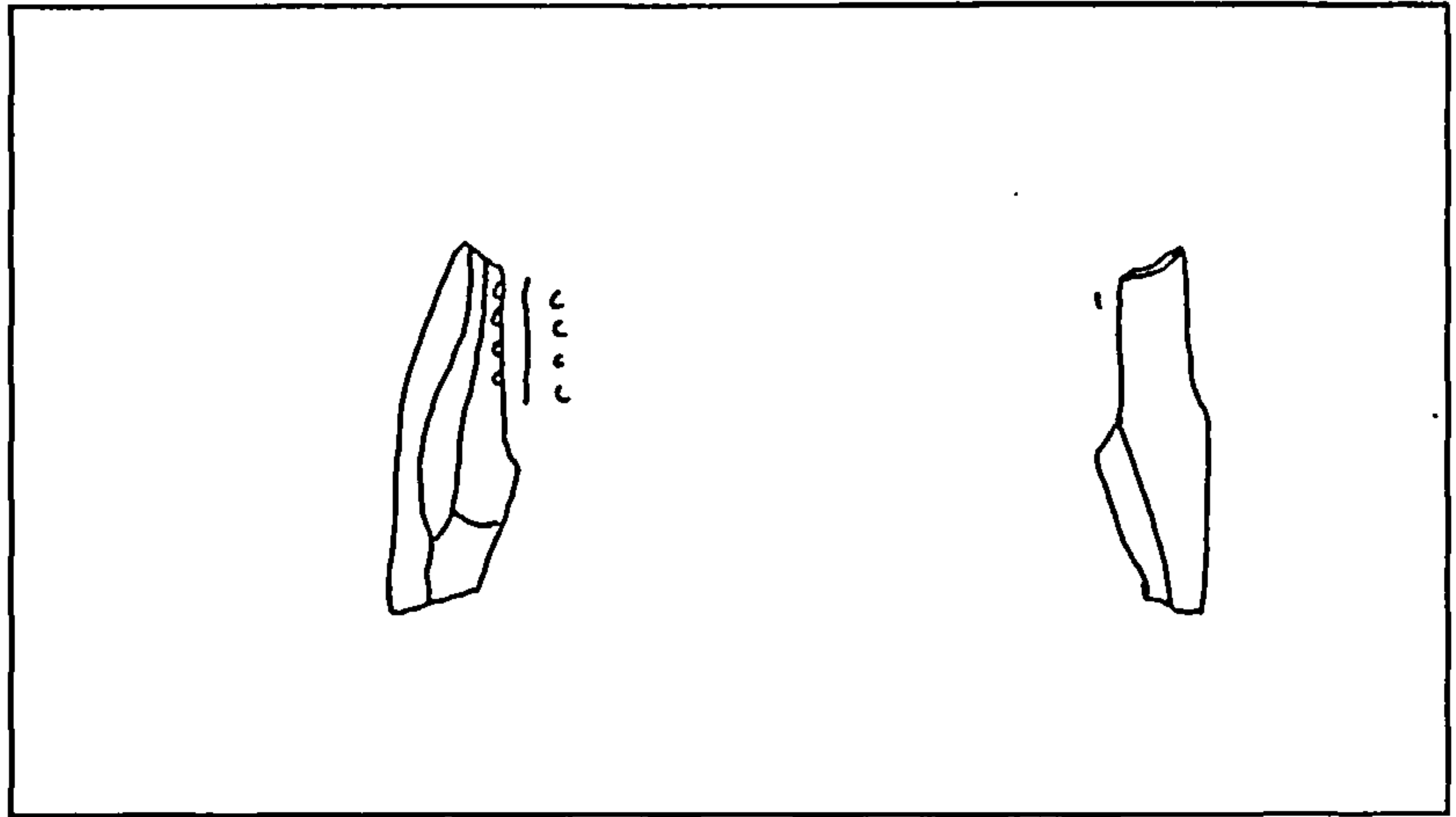
Traces:

Interior faces: restricted patches of polish away from edges. Polish is smooth reticulated to domed, with sharp edges and occasional medium irregular pits. Associated with striations running parallel to the long axis of piece

Interpretation: used, pos projectile

Comments: definitely used. Projectile use defined mainly by location of traces rather than by the traces themselves which are relatively uninformative. General distribution suggests item was an armature

Ref: SM372
Type:
Blank: BLADE
Mat: CHERT
Dim: 26x12x
Qual: MED
Cond: FRESH



Material: Grain: M Homog: V Crys: O Topo: F Fissures:
O

Edge Angle: thick

Traces:

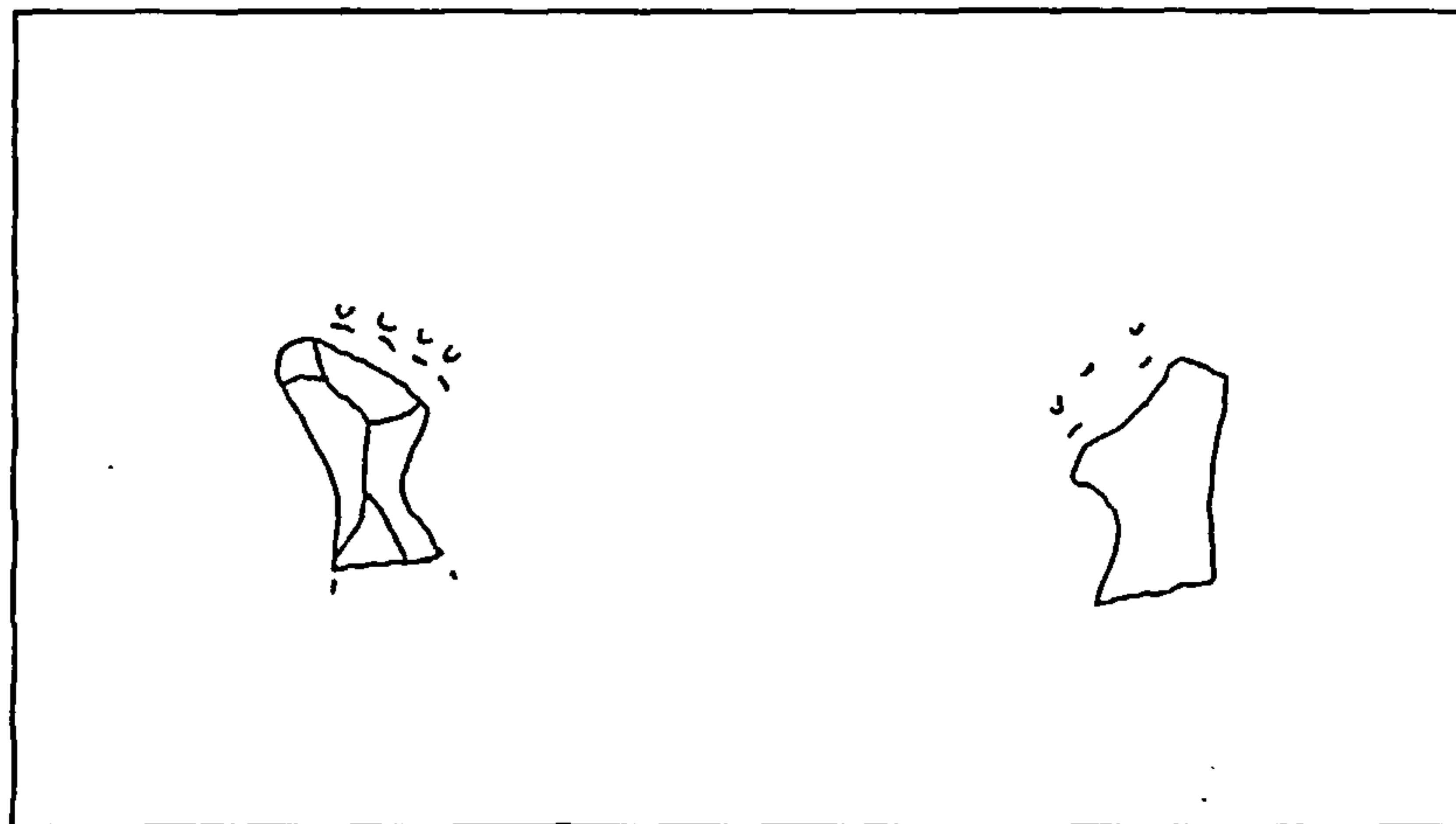
Dorsal side b: numerous clustered medium mostly step terminating deep scars associated with broad spread of polish along edge. Polish is smooth invasive, developed, with abrupt edges.

Ventral side b: minor edge damage, and slight polish

Interpretation: side b used, motion unclear, med hard material

Comments: problem: all traces on same side, unclear for motion. Numerous other traces around tool probably the result of PDSM

Ref: SM374
Type:
Blank: BLADE
Mat: FLINT
Dim: 19x10x
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
O

Edge Angle: medium

Traces:

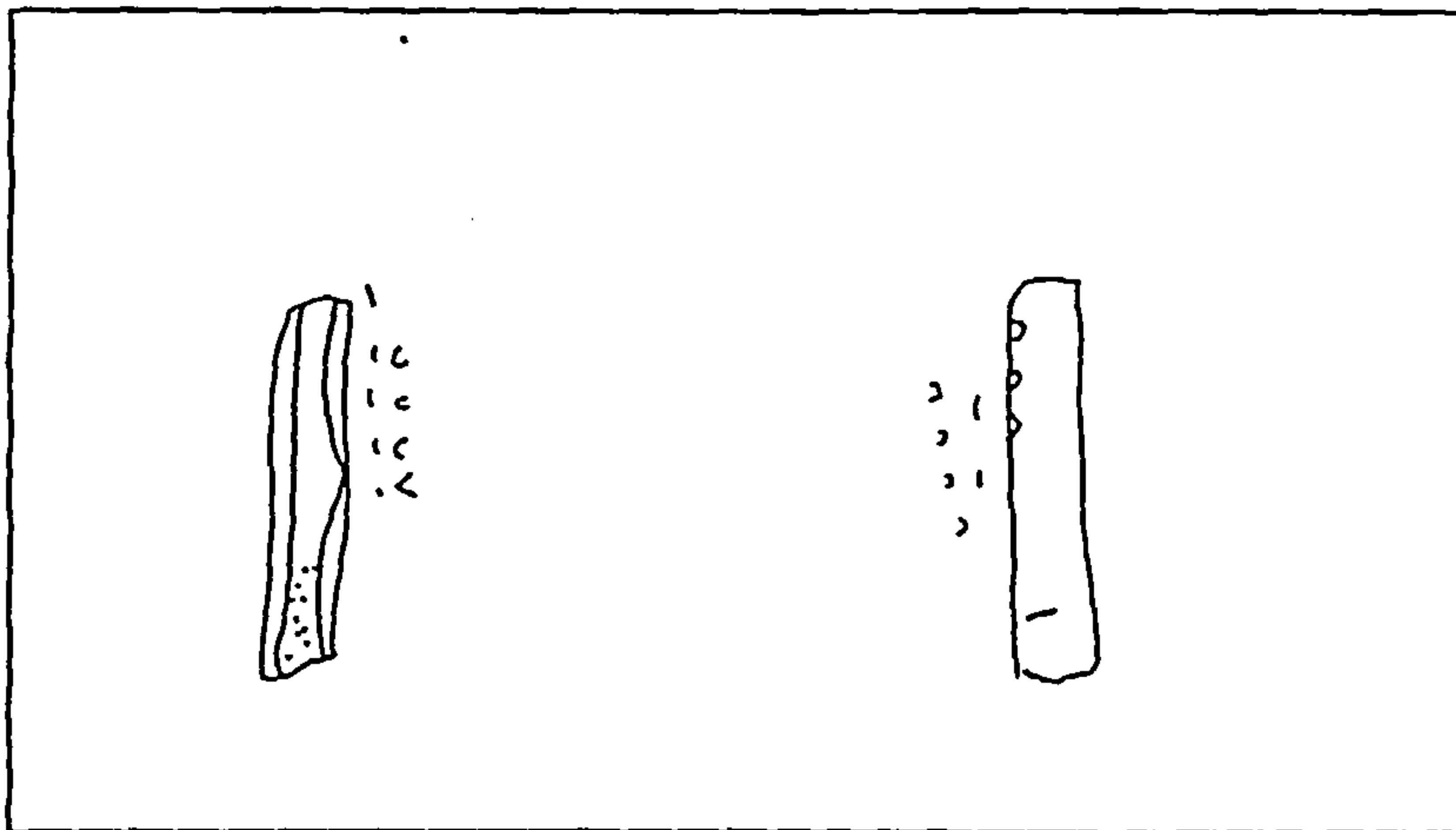
Dorsal distal: numerous clustered small to minute mixed termination deep scars associated with restricted spread of polish along edge. Polish is smooth domed, developed, not invasive into scars.

Ventral distal: minor edge damage, associated with restricted spread of polish along edge. Polish is smooth domed and invasive, developed.

Interpretation: side b used. Probably transverse motion. Probably soft material for a long time

Comments: edge damage minor, polish developed and invasive. Motion not as clear as hardness as polish virtually bifacial

Ref: SM376
Type:
Blank: BLADE
Mat: CHERT
Dim: 27x10x
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: medium

Traces:

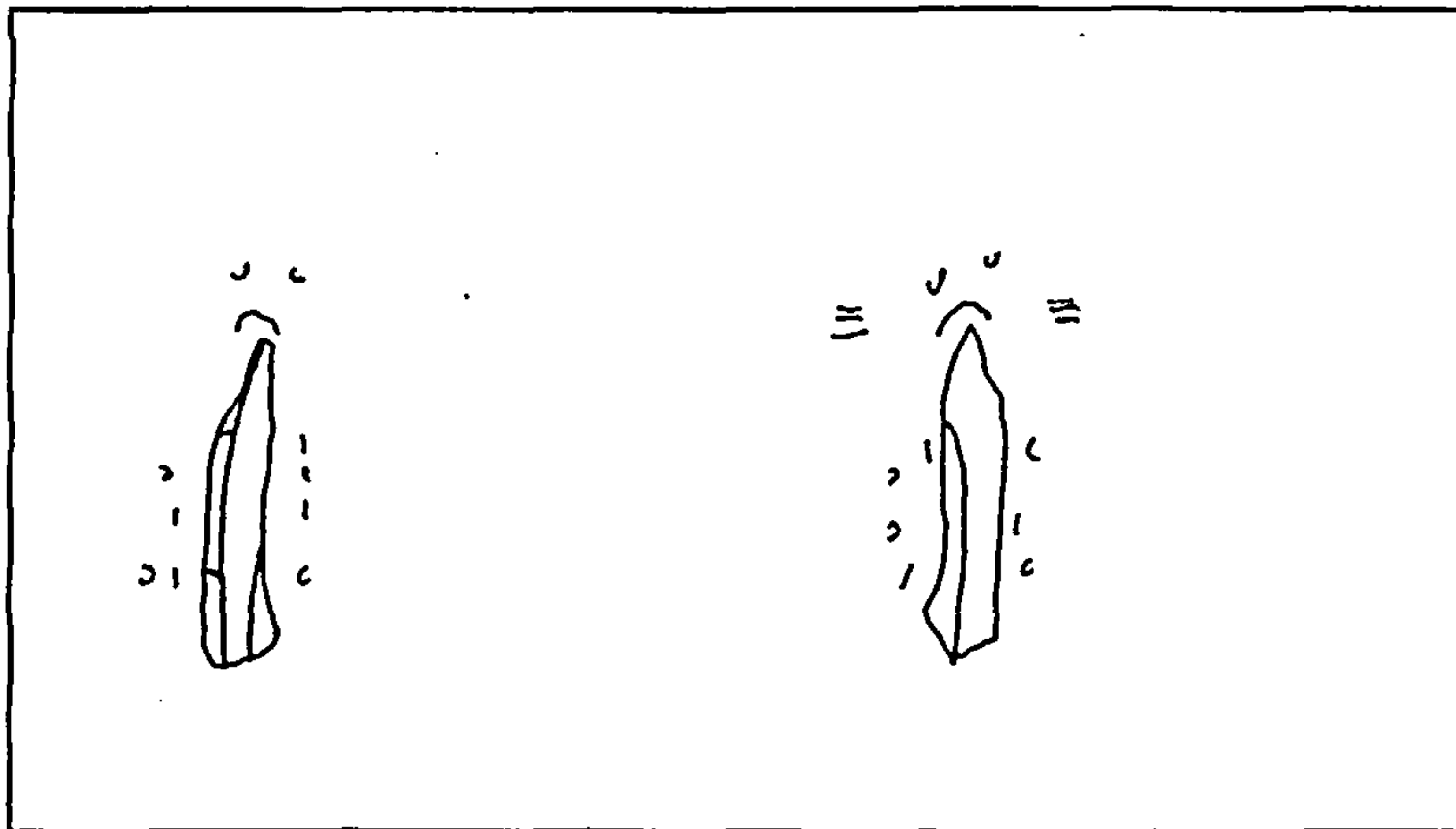
Dorsal side b: occasional clustered medium step terminating deep scars with snaps, associated with patchy polish along edge. Polish is smooth reticulated, partially linked, developed, variable, edges soft.

Ventral side b: minor edge damage, associated with patchy polish along edge. Polish is smooth reticulated, partially linked, developed, variable, edges soft. Also with a linear polish feature nearly perpendicular to edge

Interpretation: Side b used, motion unclear, hard material

Comments: Polish bifacial, edge damage unifacial, linear polish suggests transverse, but is an isolated feature

Ref: SM377
Type:
Blank: BLADE
Mat: CHERT
Dim: 27x5x
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
O

Edge Angle: point

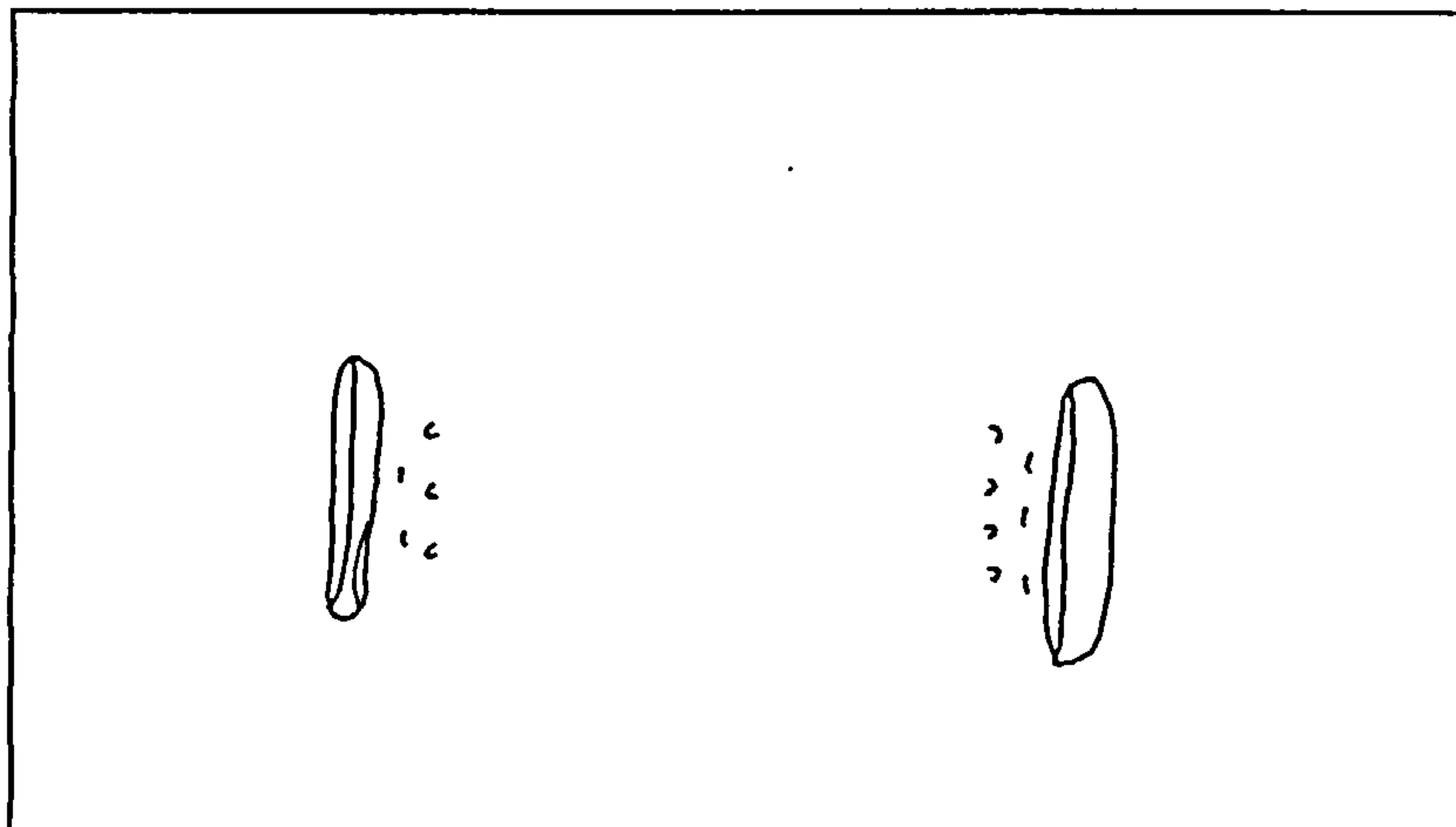
Traces:

Distal point, all faces: occasional clustered small mostly feather terminating deep scars associated with a patchy polish around edges and over tip. Polish is smooth, developed, incorporating striae running perpendicular to the edge.

Lateral edges: Along both sides and faces are indistinct polish features, with occasional scars.

Interpretation: point used, rotary motion, soft material
Comments: lateral evidence may be hafting, but equally may be PDSM

Ref: SM378
Type:
Blank: BLADE
Mat: CHERT
Dim: 12x3x
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
O

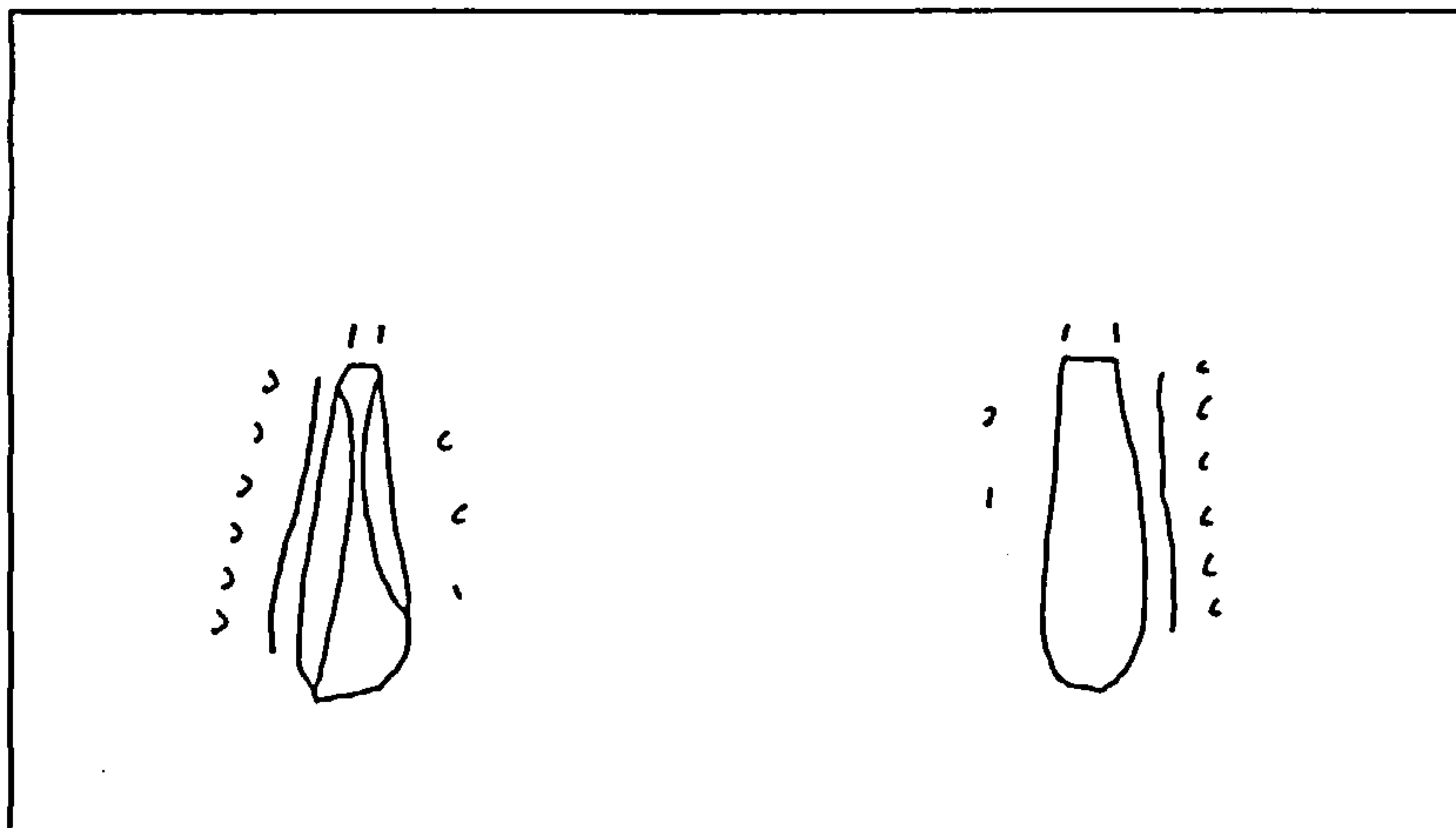
Edge Angle: thick

Traces:

Side b: both faces almost identical: occasional clustered small to minute mostly step terminating deep scars associated with restricted patches of polish on extreme edge. Polish is smooth, bright. No internal features

Interpretation: possibly opp use
Comments: very poor evidence

Ref: SM379
Type:
Blank: BLADE
Mat: FLINT
Dim: 22x10x
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: acute

Traces:

Side a, both faces are very similar: frequent clustered medium to small mostly step terminating deep scars with snaps, associated with broad spread of polish along edge. Polish is smooth but not invasive, developed, confined to edge.

Side b: some irregular traces along side b on both faces

Interpretation: Side a used. Long motion, probably hard material

Comments: shallow penetration, reticulated polish in association with edge damage suggest hard material. Traces on b indistinct, but conceivably hafting

Smittons: Sample with wear traces

N	TYPE		MOTION	HARD	MAT	FUNCTION	NOTES
---	-----		-----	-----	-----	-----	-----
3	USED	OPP	LONG				MARGINAL
3	USED		LONG	HARD	STONE?	S-A-L?	
18	USED	OPP	LONG	HARD			
22	USED	OPP	LONG	HARD			HARD WORK
26	USED		TRANSV	SOFT			V LEAD
38	USED	OPP	LONG	?		S-A-L?	TECHNO?
56	USED		LONG	MED H		GROOVE	CORNER
57	USED		LONG	SOFT	HIDE?	(GROOVE)	INTENSE
58	USED		LONG	MED	WOOD	GROOVE	
58	USED		TRANSV	HARD			
59	USED		TRANSV	MED H	WOOD?	SHAVE	INTENSE
60	USED		LONG	HARD		CUT	
75	USED		TRANSV	MED S			NOT RETOUCH
76	USED		TRANSV	SOFT			MED S?
78	USED		LONG	SOFT			SHORT USE?
81	USED		LONG	SOFT		GROOVE	
88	USED		TRANSV	MED		SHAVE	INTENSE
91	USED	OPP	PIERCE	SOFT?		NEEDLE?	GENTLE/SOFT?
92	USED		BIDIR	MED S		SAW	PENETRATES
110	USED	OPP	LONG				
130	USED		LONG	HARD		S-A-L?	DIFFICULT
131	USED		TRANSV	MED		SHAVE	
146	USED		LONG	HARD			
148	USED		LONG	MED			
154	USED		TRANSV	SOFT			
162	USED		COMPLE				
163	USED		TRANSV	MED			
164	USED	OPP	TRANSV				MARGINAL
191	USED		TRANSV	MED	WOOD?	SCRAPE	NOSE
193	USED		LONG	MED			
195	USED		TRANSV	MED H	WOOD?		
208	USED		LONG	MED S			
213	USED	OPP	TRANSV	MED S			
217	USED		LONG	HARD			
250	USED	OPP	TRANSV				
264	USED		LONG			PROJ/BORE ?	
300	USED		IMPACT				POST RETOUCH
314	USED		LONG	MED H		GROOVE	
317	USED		LONG	MED H			
319	USED		GRIND?				
322	USED	OPP	TRANSV				MARGINAL
323	USED		LONG	SOFT			
325	USED		TRANSV	MED S		(NOTCH)	
330	USED		TRANSV	MED	HIDE?		
332	USED		LONG	HARD		CUT (1 DIR	
334	USED		TRANSV				
N	TYPE		MOTION	HARD	MAT	FUNCTION	NOTES
---	-----		-----	-----	-----	-----	-----
336	USED		TRANSV	HARD		SHAVE	

344	USED		TRANSV	HARD		SHAVE	
348	USED	OPP	LONG	SOFT			SOFT MAT!?
349	USED						FRAG,
350	USED		LONG	HARD	BONE/A		
351	USED		LONG	HARD	ANTLER	GROOVE	
355	USED		IMPACT			PROJ	
357	USED		IMPACT			PROJ	
359	USED	OPP					
360	USED	OPP					
361	USED		LONG	MED S		GROOVE	+ HAFTING
362	USED		LONG	HARD	BONE/A	GROOVE	
363	USED	OPP		HARD			+ LATERAL
364	USED		LONG			PROJ?	
365	USED		TRANSV	MED H		SCRAPE	
369	USED		LONG			PROJ	ARMATURE?
372	USED		TRANSV	MED H	WOOD?	SHAVE	
374	USED		TRANSV	SOFT			INTENSE
376	USED		TRANSV	HARD		SHAVE	
377	USED		PIERCE	MED S	HIDE?		
378	USED	OPP	LONG				
379	USED		LONG	MED H	WOOD?	CUT	

Smittons, sample selected for funtional analysis

N	Mat	Blank	PSI	R/I	RET	TYPE
-----	---	-----	---	---	---	-----
3	C	CH	S		L	USED
17	F	F	I	R	L	PDSM
18	F	B	I	R	Y	USED OPP
19	F	B	I	R	Y	UNUSED
20	F	B	I	R	Y	PDSM
21	F	B	I	R	Y	TECHNO
22	F	B	I	R	Y	USED OPP
23	F	B	I	R	Y	UNUSED
26	F	B	I	R	L	USED
34	C	CH	I		N	UNUSED
35	C	PEB			N	PDSM
36	C	F	I	I	N	UNUSED
37	F	F	I	R	N	PDSM
38	F	B	I	R	N	USED OPP
39	F	F	P	I	N	UNUSED
40	C	F	I	I	N	UNUSED
41	C	CH	I		N	UNUSED
42	C	B	I	R	Y	PDSM
56	F	F	I	R	L	USED
57	C	F	I	R	L	USED
58	C	B	I	R	L	USED
59	C	B	I	R	L	USED
60	C	B	S	R	L	USED
72	C	CH	I	I	Y	UNUSED
73	C	CH	I	I	Y	UNUSED
74	C	CH	S	I	Y	UNUSED
75	C	CH	S	I	Y	USED
76	C	CH	S	I	L	USED
78	C	F	I	R	L	USED
79	C	F	I	R	L	UNUSED
80	C	B	I	R	L	PDSM
81	C	F	I	R	L	USED
87	C	F	I	R	L	UNUSED
88	C	F	I	R	L	USED
89	C	F	I	R	L	UNUSED
90	C	F	S	I	L	PDSM
91	C	B	I	R	L	USED OPP
92	C	B	I	R	L	USED
96	C	B	I	R	N	UNUSED
106	C	B	I	R	N	UNUSED
110	C	B	I	R	L	USED OPP
112	C	B	I	R	L	UNUSED
128	C	F	I	R	L	UNUSED
129	F	F	I	R	L	UNUSED
130	F	B	I	R	L	USED
131	F	F	I	R	L	USED
N	Mat	Blank	PSI	R/I	RET	TYPE
-----	---	-----	---	---	---	-----
144	C	F	I	I	L	TECHNO

N	Mat	Blank	PSI	R/I	RET	TYPE
-----	----	-----	----	----	----	-----
144	C	F	I	I	L	TECHNO
145	C	F	S	I	Y	TECHNO
146	C	F	I	R	L	USED
147	C	F	I	R	L	UNUSED
148	C	B	I	R	L	USED
149	C	F	S	R	L	PDSM
154	F	F	I	R	L	USED
157	C	F	I	R	L	PDSM
162	F	B	S	R	L	USED
163	F	F	I	R	Y	USED
164	F	F	I	R	L	USED OPP
165	F	F	I	R	Y	TECHNO
176	C	B	I	R	N	PDSM
188	C	CORE/C			N	UNUSED
191	F	F	S	R	Y	USED
193	F	F	S	R	N	USED
195	C	F	I	I	L	USED
196	C	B	I	R	N	PDSM
198	F	F	I	R	N	UNUSED
207	F	F	S	I	N	TECHNO
208	F	B	I	R	N	USED
209	C	F	I	I	N	UNUSED
210	C	CORE			N	TECHNO
211	F	B	I	R	L	UNUSED
212	F	F	I	R	N	PDSM
213	F	F	S	R	N	USED OPP
214	F	B	I	R	N	PDSM
215	F	CORE			N	UNUSED
216	F	B	I	R	L	PDSM
217	F	F	S	R	L	USED
218	F	B	I	R	N	UNUSED
222	C	B	S	R	N	UNUSED
223	F	CORE	S		N	TECHNO
224	F	F	I	I	N	UNUSED
226	F	B	I	R	N	UNUSED
227	F	F	I	R	N	UNUSED
228	F	F	I	R	N	UNUSED
229	F	CORE			N	UNUSED
230	C	F	I	R	N	PDSM
240	C	CORE/C			N	TECHNO
242	F	F	I	R	L	UNUSED
250	F	F	S	R	Y	USED OPP
264	C	B	I	R	Y	USED
265	C	B	I	R	Y	TECHNO
266	C	B	I	R	Y	UNUSED
267	C	B	I	R	Y	UNUSED
268	C	B	I	R	Y	UNUSED
269	C	B	I	R	Y	TECHNO
270	C	B	I	R	L	UNUSED

303	F	B	I	R	Y	TECHNO
304	F	B	I	R	Y	TECHNO
305	F	B	I	R	N	UNUSED
310	F	B	I	R	N	UNUSED
311	C	B	I	R	N	UNUSED
312	C	B	I	R	Y	UNUSED
313	C	B	I	R	N	PDSM
314	C	F	I	R	N	USED
315	C	F	I	R	L	UNUSED
316	C	F	I	R	N	PDSM
317	C	F	I	R	N	USED
318	C	F	I	R	N	UNUSED
319	C	CORE			N	USED
320	C	B	I	R	N	TECHNO
321	C	F	I	R	N	UNUSED
322	C	F	S	R	N	USED OPP
323	C	B	I	R	N	USED
324	C	F	I	R	N	PDSM
325	C	F	I	R	N	USED
326	C	F	I	I	N	PDSM
327	C	F	I	R	N	PDSM
328	C	CORE			N	PDSM
329	C	B	I	R	L	PDSM
330	C	F	I	R	N	USED
331	C	CH	I		N	UNUSED
332	F	B	I	R	L	USED
333	C	F	I	R	N	UNUSED
334	C	F	I	R	L	USED
335	C	B	I	R	N	PDSM
336	C	F	I	R	N	USED
337	C	F	S	R	Y	UNUSED
338	C	F	S	R	N	UNUSED
339	C	B	I	R	N	UNUSED
340	C	F	S	R	N	UNUSED
341	C	B	I	R	N	UNUSED
342	C	F	I	I	N	UNUSED
343	C	B	S	R	N	UNUSED
344	C	F	I	R	N	USED
345	C	B	I	R	N	PDSM
347	C	F	S	R	L	UNUSED
348	F	B	I	R	N	USED OPP
349	C	B	I	R	N	USED
350	C	F	I	R	N	USED
351	C	B	I	R	N	USED
N	Mat	Blank	PSI	R/I	RET	TYPE
-----	----	-----	----	----	----	-----
354	F	F	I	R	Y	PDSM
355	C	B	I	R	Y	USED
356	F	B	I	R	Y	UNUSED
357	C	B	I	R	Y	USED
358	C	F	I	R	N	PDSM
359	C	F	I	R	N	USED OPP
360	C	B	I	R	N	USED OPP
361	C	B	I	R	N	USED
362	F	F	S	R	N	USED

363	C	F	I	R	N	USED OPP
364	C	B	I	R	Y	USED
365	C	F	S	R	N	USED
366	F	B	I	R	Y	PDSM
367	C	B	I	R	Y	PDSM
368	C	B	I	R	Y	PDSM
369	C	B	I	R	Y	USED
370	C	F	I	R	N	PDSM
371	F	F	I	R	N	UNUSED
372	C	F	I	R	Y	USED
373	F	F	I	I	N	PDSM
374	F	F	I	R	N	USED
375	F	F/CORE	S	R	N	PDSM
376	C	B	S	R	L	USED
377	F	F	I	I	Y	USED
378	C	B	I	R	N	USED OPP
379	F	B	I	R	L	USED
380	C	F	S	I	Y	UNUSED
381	C	B	I	R	N	UNUSED
382	F	B	I	R	Y	PDSM

Appendix C2

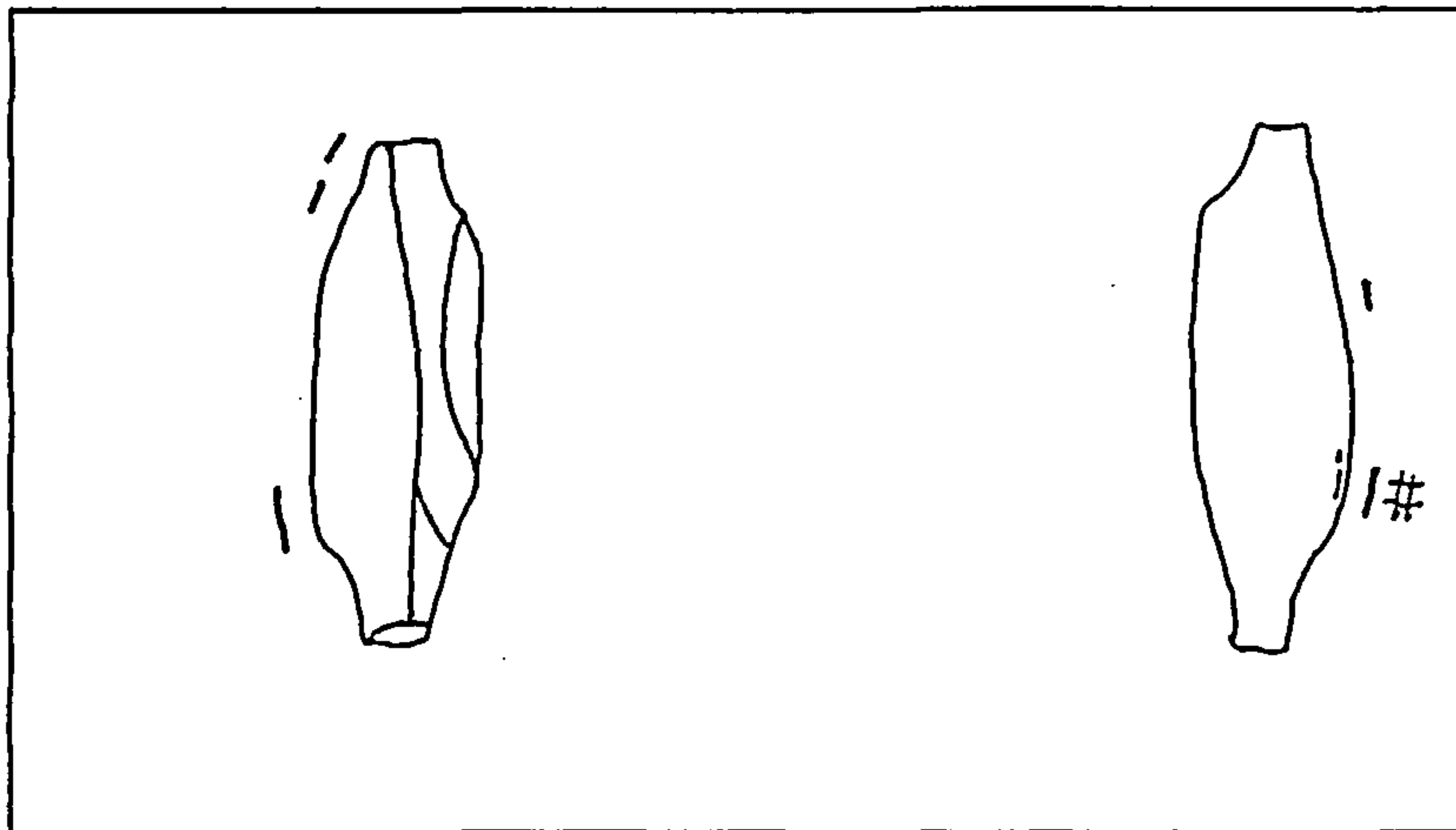
Starr, functional analysis, basic data

Refer to appendix B for information on recording system

All the pieces interpreted as "used" are described individually, giving a brief textual description of the more significant features to allow quick assessment of these pieces. More detailed information is kept on archive in the Dept of Archaeology, University of Edinburgh.

Following this piece by piece information are various summary tables detailing the complete sample.

Ref: S1001
Type:
Blank: BLADE
Mat: FLINT
Dim: 24x10x2
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A

Edge Angle: acute

Traces:

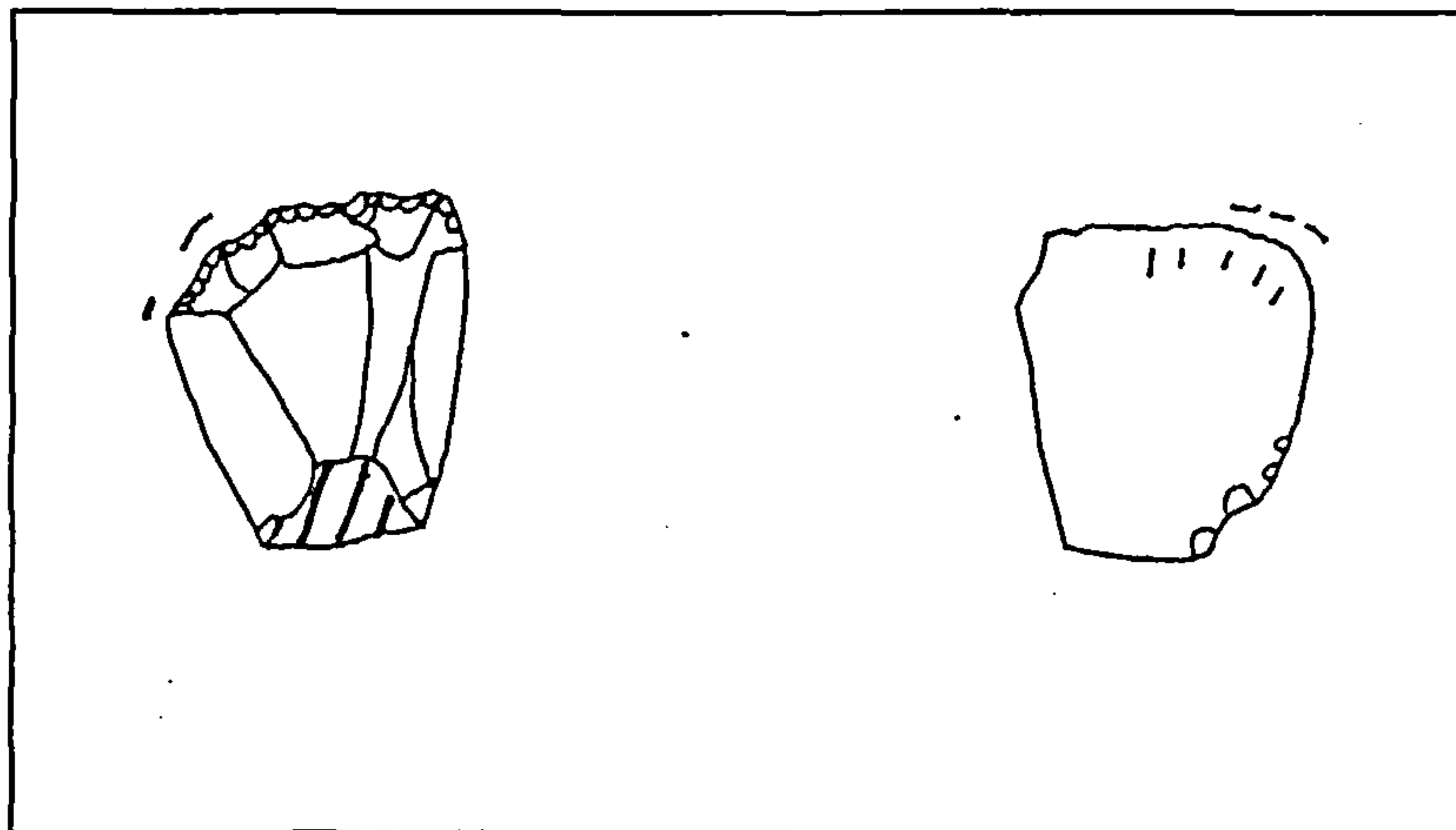
Side a, both faces: Edge very fresh. Patchy medium linear polish along edge. Polish smooth very domed, allover, developed, with sharp edges and occasional minute irregular pits. Associated parallel and perpendicular medium medium fine cross common clustered striations. Polish forms an edge bevel, more marked on dorsal face.

On ventral away from side a broad spread of polish. Polish is smooth flat, scattered, developed, bright with abrupt edges and occasional small irregular pits.

Interpretation: Side a used, longitudinal motion, deep penetration, soft material, long time, possibly with inclusions

Comments:

Ref: S1011
Type: SCRAPER
Blank: FLAKE
Mat: FLINT
Dim: 20x21x9
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A

Edge Angle: thick

Traces:

Edge damage not recorded because of retouch

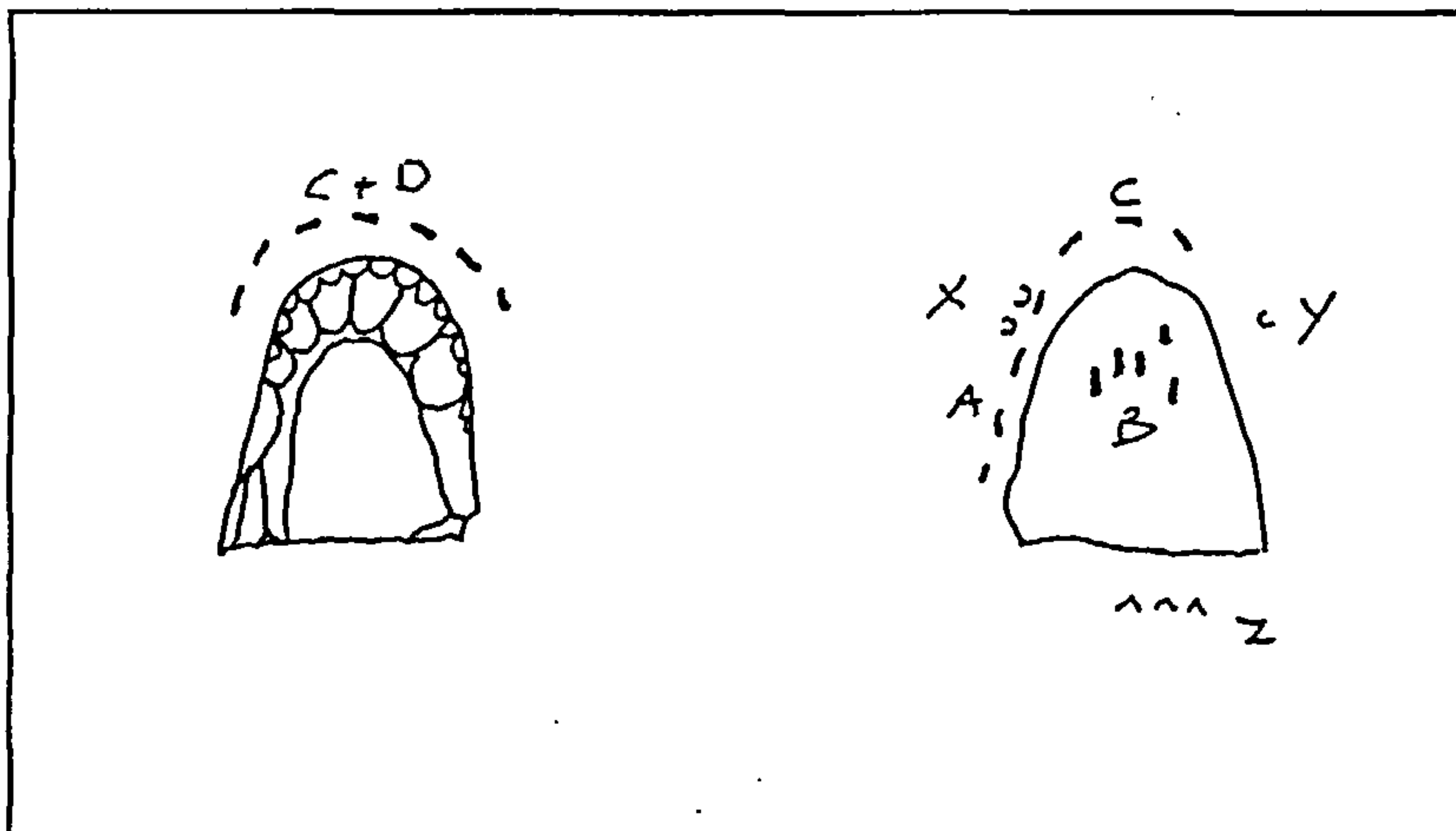
Dorsal distal: Broad spread of polish along edge. Polish is smooth domed and invasive, all over, developed, bright, with sharp edges and no internal features. Also restricted patches of polish away from edge. Polish is smooth domed, all over, developed, bright, with abrupt edges and no internal features.

Ventral distal: Broad spread of polish along edge. Polish is smooth domed and invasive, all over, developed, bright, with sharp edges and no internal features. Also linear polish perpendicular to distal on interior. Polish is rough reticulated, scattered, poor with gradual edges and no internal features.

Interpretation: Distal corner used, deep penetration, soft material

Comments: Very distinct

Ref: S1014
Type: SCRAPER
Blank: FLAKE
Mat: FLINT
Dim: 19x20x8
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures: A

Edge Angle: thick

Traces:

Very complex. Edge damage impossible on dorsal because of retouch.

At X: Rare clustered small to medium step terminating deep scars.

At Y: Rare clustered large mostly feather terminating deep scars.

At Z: Frequent clustered and layered medium to small mostly step deep scars.

Polish A: restricted pathes on edge. Smooth domed (reticulated) partially linked, developed, variable, with sharp edges and common medium irregular pits. Polish B: Patchy (partially linear, parallel to long axis) broad spread, away from edge and on interior. Smooth flat, allover, intense, bright, with abrupt edges and occasional variable irregular pits. On dorsal associated with 450 medium deep broad random frequent clustered striations.

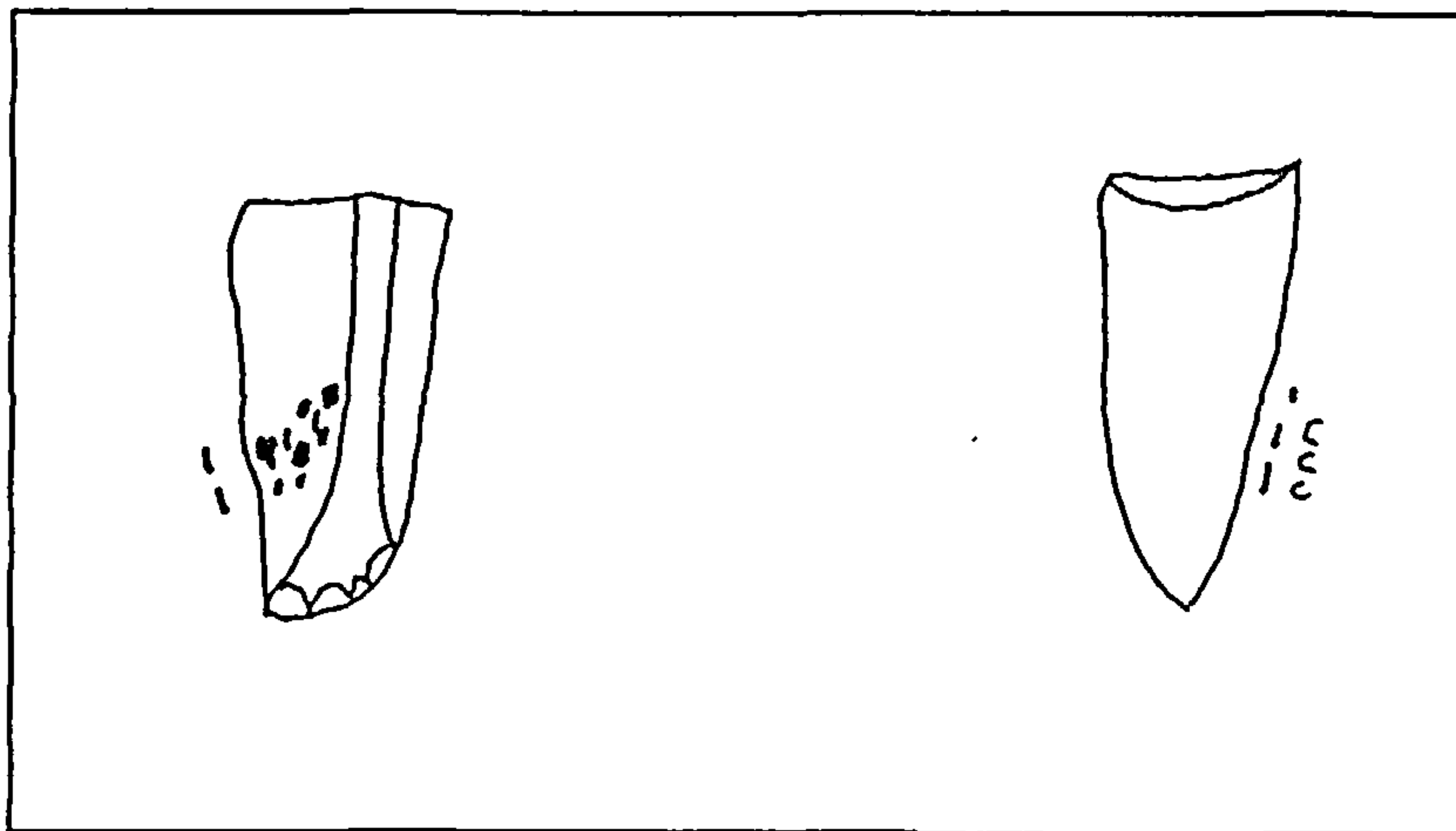
Polish C: Patches on edge (and around scar arretes). Smooth invasive (reticulated), partially linked, edges gradual with no internal features.

Polish D: Patches on edge (and around scar arretes). Smooth domed, allover. developed, variable, with gradual edges and common medium circular pits.

Interpretation: Used, complex

Comments: Used, snapped, retouched, used again? All one purpose

Ref: S1026
Type:
Blank: BLADE
Mat: FLINT
Dim: 20x10x3
Qual: GOOD
Cond: SW



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A

Edge Angle: medium

Traces:

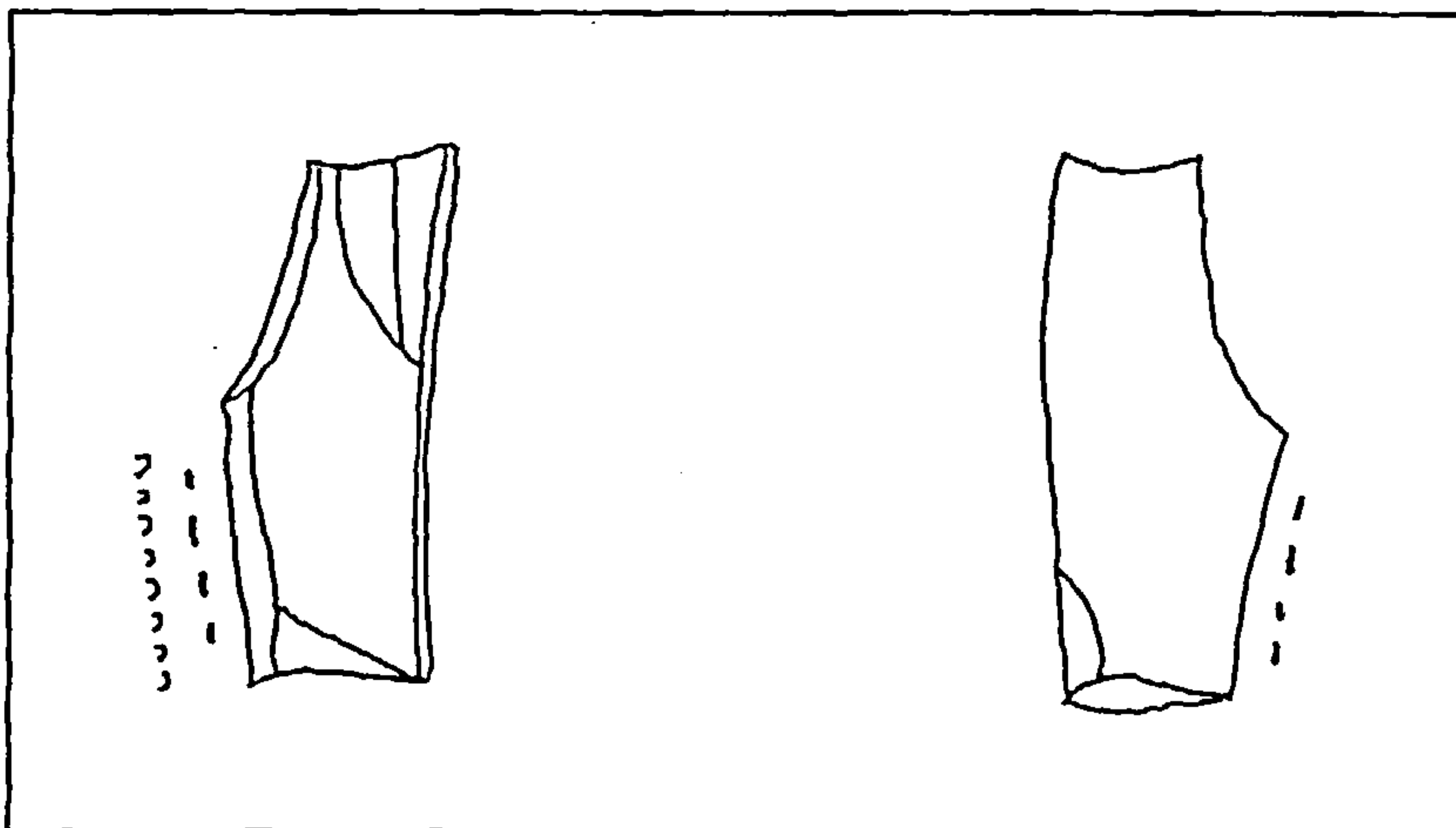
Dorsal side a: No edge damage. Patchy spread of polish from away from edge to interior face. Polish is smooth flat (domed), partially linked, developed, with sharp edges and frequent variable irregular pits. Associated are perpendicular short deep broad parallel clustered frequent striations.

Ventral side a: Occasional clustered large mostly feather terminating deep scars associated with restricted linear polish along edge. Polish is smooth invasive, partially linked, poor, with gradual edges and no internal features

Interpretation: Side a used. Transverse motion. Deep penetration, soft material.

Comments:

Ref: S1048
Type: ED
Blank: BLADE
Mat: FLINT
Dim: 40x20x10
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures: A

Edge Angle: thick

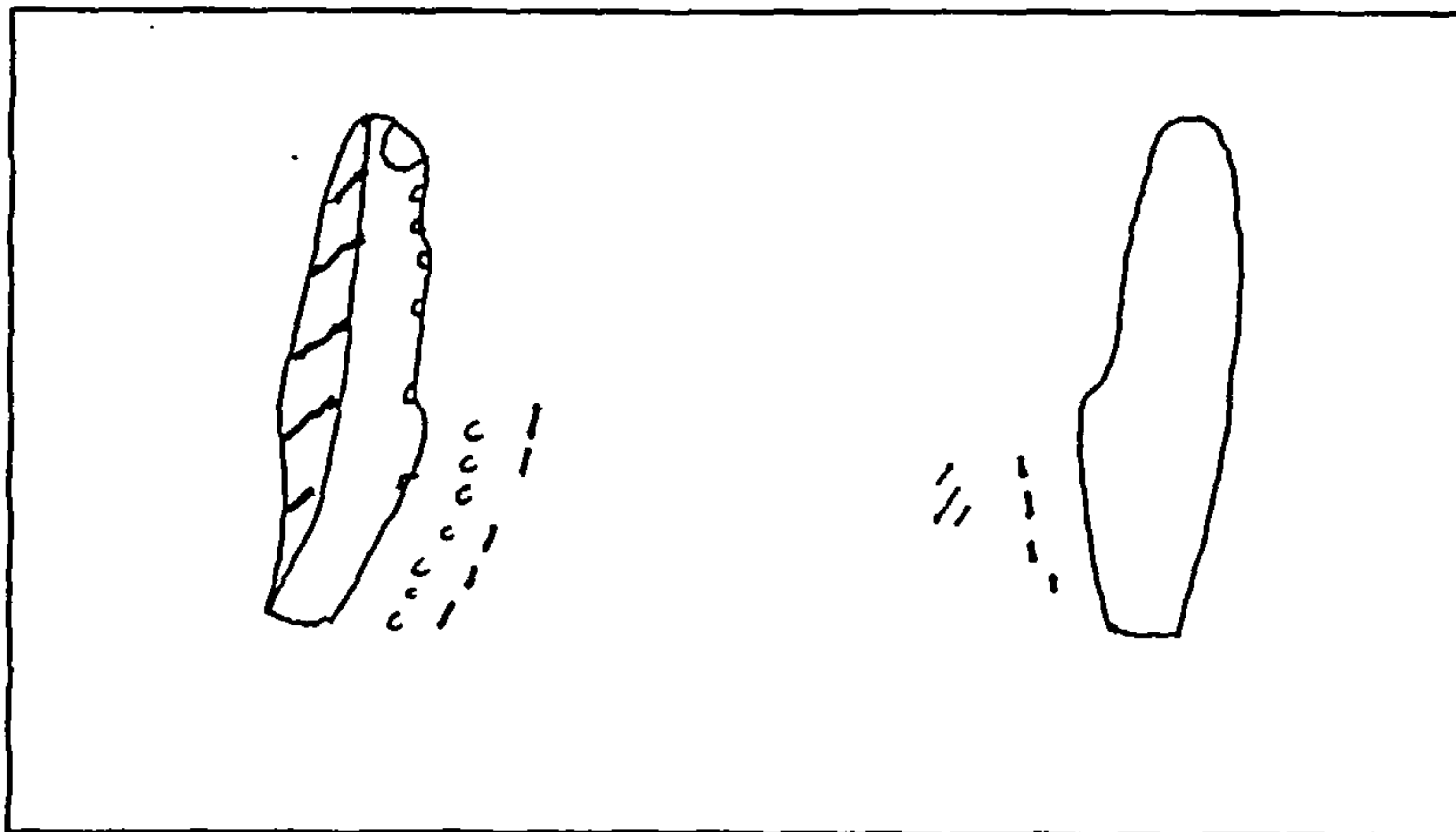
Traces:

Dorsal side a: common clustered medium to small step terminating deep scars with associated broad spread of polish along and away from edge. Polish is rough reticulated, scattered, with gradual edges and common small irregular pits.

Ventral side a: no edge damage. Restricted patchy polish in edge. Smooth domed (reticulated) partially linked, with gradual edges and common small irregular pits. Associated with perpendicular short deep fine parallel rare striations. Best between reverse of scars on dorsal

Interpretation: Used (opp/marginal) transverse motion
Comments: rest of piece very fresh, making these marginal traces convincing

Ref: S1049
Type: ED
Blank: BLADE
Mat: FLINT
Dim: 34x11x4
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: medium

Traces:

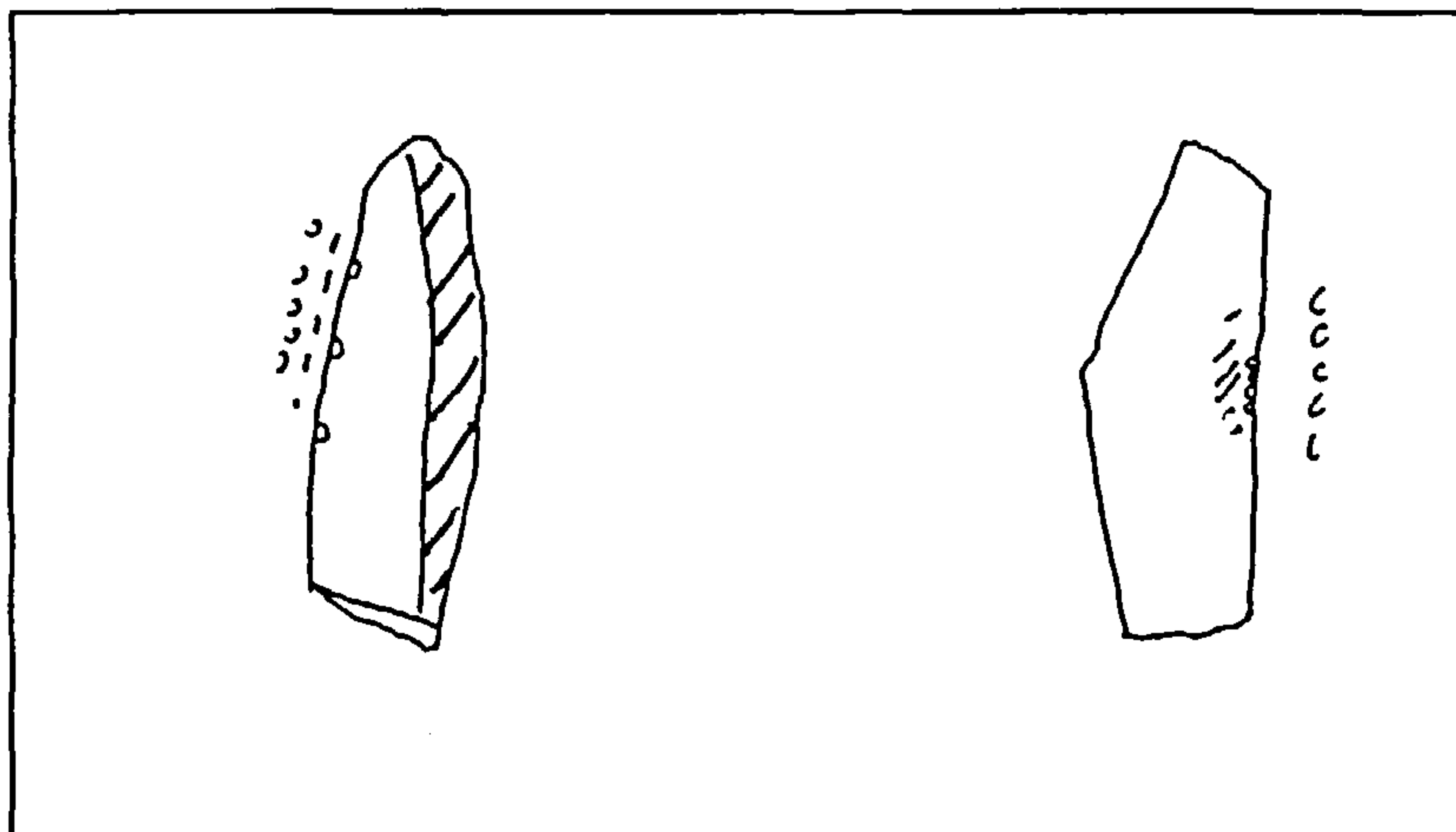
Dorsal side a: Common clustered and layered medium step terminating deep scars associated with A: patchy spread on and way from edge. Polish is smooth domed, partially linked, poor with gradual edges and occasional medium irregular pits, also with B: restricted patches away from edge. Polish is smooth flat, partially linked, with sharp edges and occasional medium irregular pits. Slight bevel on edge.

Ventral side a: No edge damage. Patchy spread along edge. Polish is smooth invasive (reticulated) partially linked, poor, with soft edges and no internal features. Associated with 450 short deep fine parallel common striations

Interpretation: Side a used. Transverse motion. Med hard material

Comments: Edge damage serious compared to polish. Most traces on one face only, shaving?

Ref: S1050
Type: ED
Blank: BLADE
Mat: FLINT
Dim: 37x17x5
Qual: GOOD
Cond: FRESH



Material: Grain: M Homog: H Crys: A Topo: F Fissures: A

Edge Angle: acute

Traces:

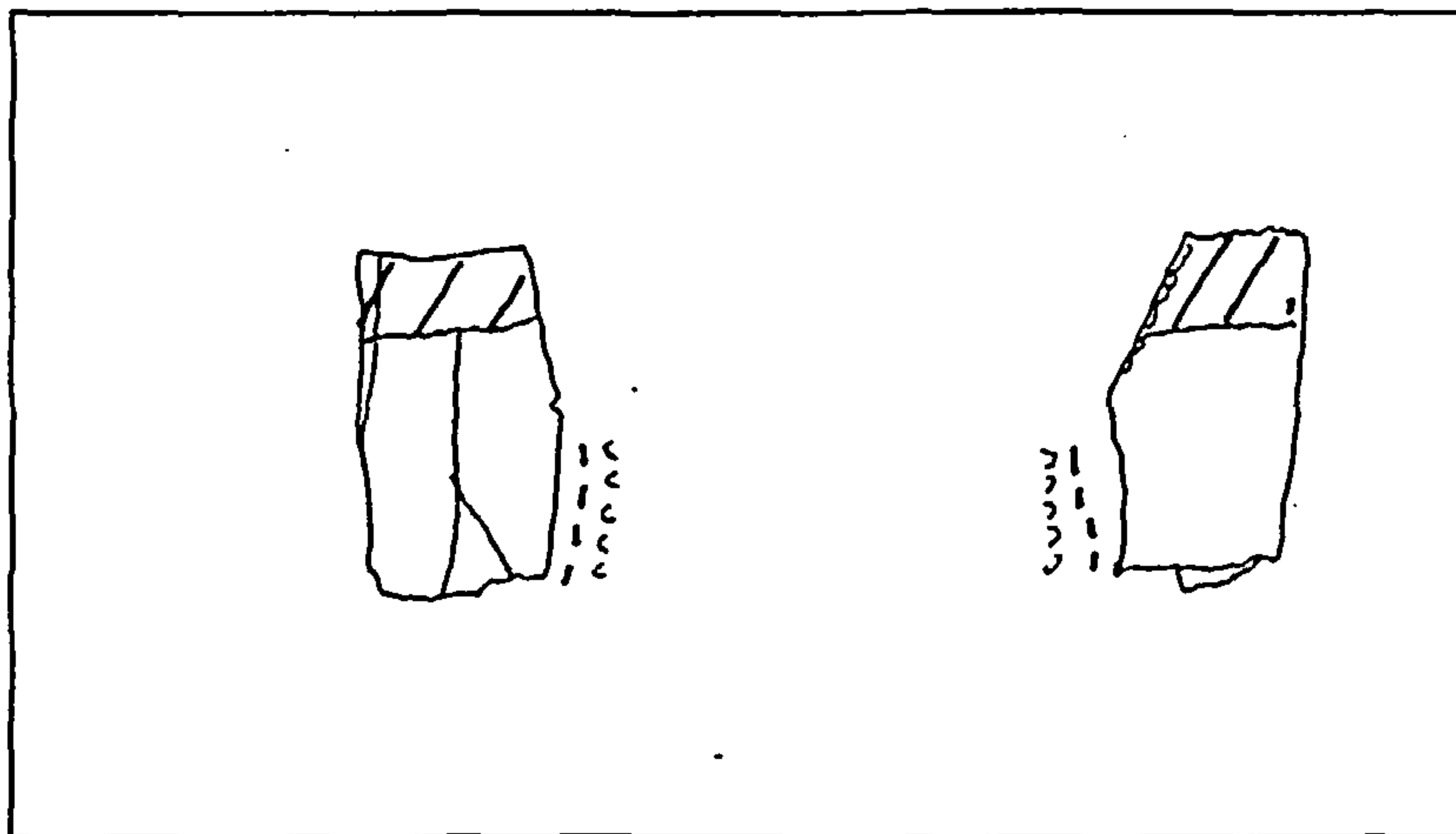
Dorsal side a: common clustered small mostly step terminating deep scars, associated with a restricted patchy polish along the edge. Polish is smooth domed, all over, with gradual edges and occasional small circular pits. Edge bevel.

Ventral side a: common clustered large mostly step terminating deep scars, with bidirectional scarring, associated with a broad linear polish as 45° to the edge. Polish is smooth flat, scattered, developed, bright, with abrupt edges and occasional small irregular pits.

Interpretation: side a used. Probably long, bidirectional motion.

Comments: Difference in polish pattern differential cross section

Ref: S1051
Type: ED
Blank: FLAKE
Mat: FLINT
Dim: 19x13x4
Qual: MED
Cond: SW



Material: Grain: F Homog: H Crys: A Topo: F Fissures: A

Edge Angle: thick

Traces:

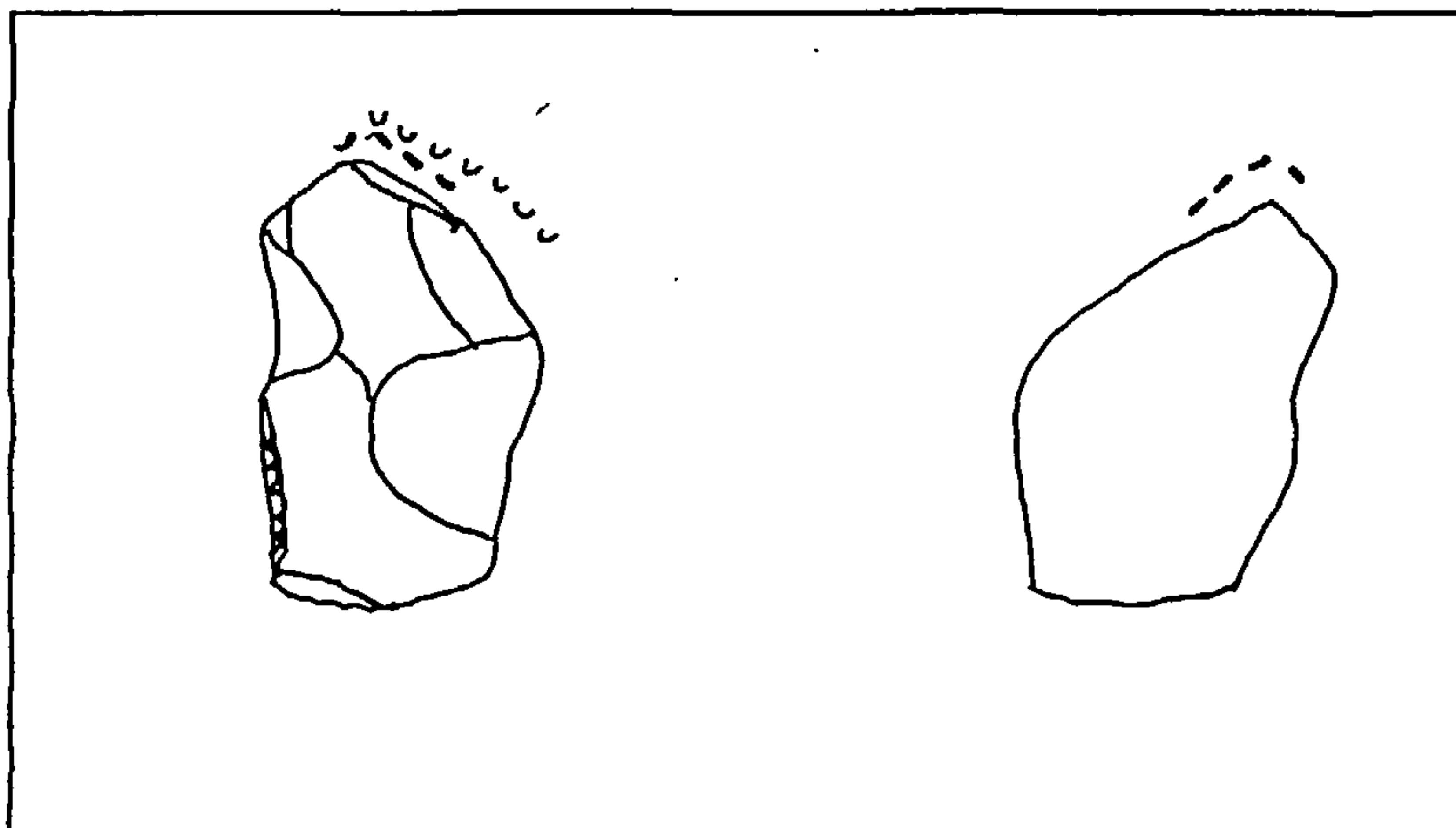
Dorsal side b: frequent clustered minute mostly feather terminating mostly deep scars associated with a patchy polish on edge. Polish is smooth domed (invasive), allover, developed, bright, with gradual edges and common small circular pits. .

Ventral side b: Common clustered small mixed terminating mixed scars associated with a patchy polish on edge. Polish is smooth domed (invasive), allover, developed, bright, with gradual edges and common small circular pits. Associated perpendicular medium deep narrow occasional striations

Interpretation: side b used. soft material

Comments: by itself any one feature unconvincing. Also other polishes interpreted as PDSM

Ref: S1052
Type: ED
Blank: FLAKE
Mat: CHERT
Dim: 19x15x4
Qual: EXC
Cond: FRESH



Material: Grain: M Homog: H Crys: C Topo: F Fissures:
O

Edge Angle: thick

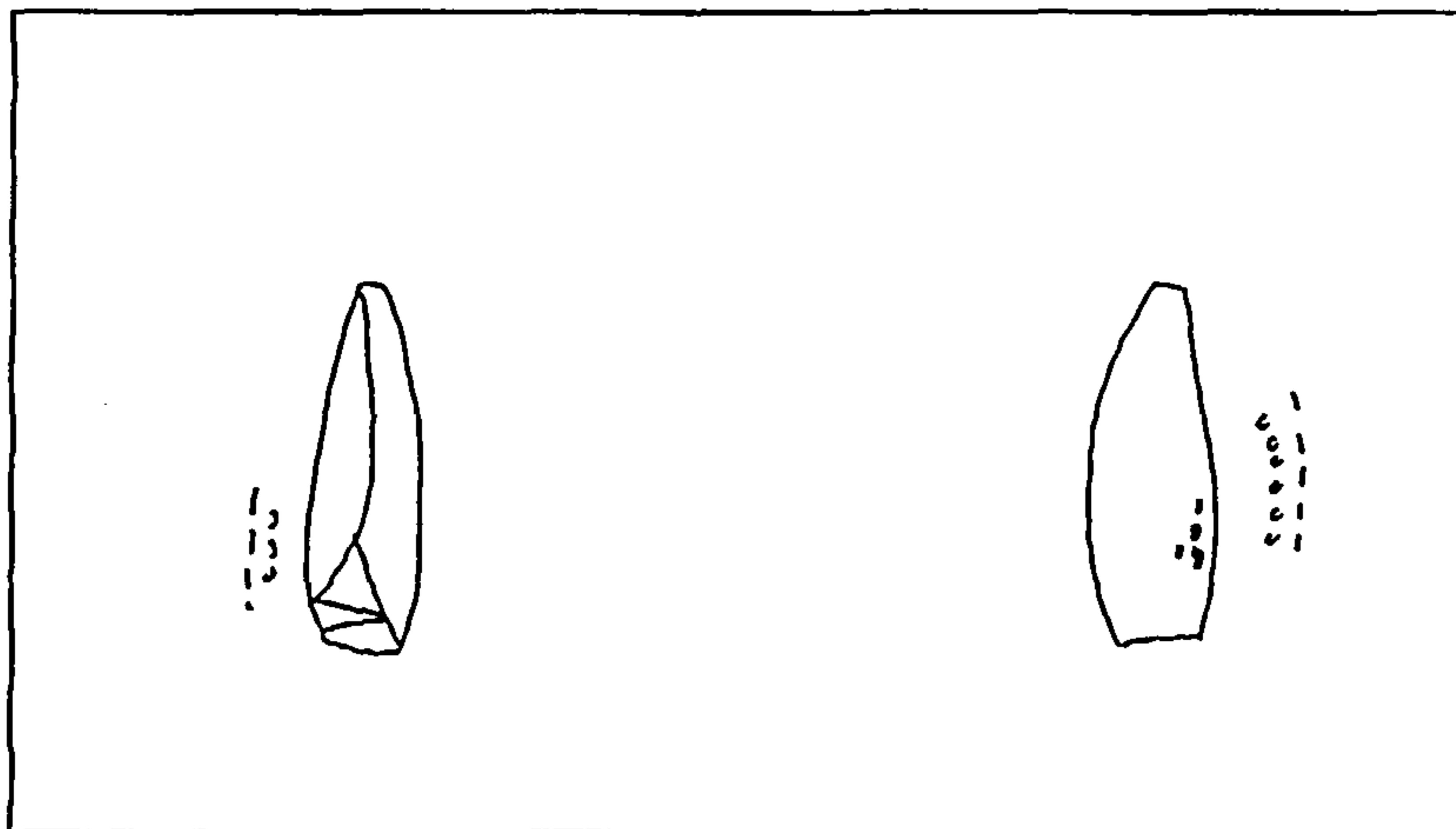
Traces:

Dorsal distal: common clustered medium mostly feather terminating deep scars with associated C: restricted patchy polish away from edge. Polish is smooth flat reticulated, scattered, with sharp edges and occasional small irregular pits. Also with D: restricted patchy polish along edge. Polish is smooth flat (rippled), allover, developed, bright, with abrupt edge and common variable irregular pits.

Ventral distal: No edge damage. Polish A: patchy linear polish along edge. Polish is rough reticulated, scattered, with gradual edges and no internal features. Polish B: restricted patchy polish on edge. Polish is smooth flat, partially linked, with sharp edges and occasional medium irregular pits.

Interpretation: Distal used, transverse motion
Comments:

Ref: S1055
Type: ED
Blank: BLADE
Mat: FLINT
Dim: 17x7x3
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: medium

Traces:

Dorsal side a: common clustered minute mostly feather terminating mixed scars associated with C: restricted narrow linear polish along edge. Polish is smooth domed, allover, developed, variable with sharp edges and no internal features

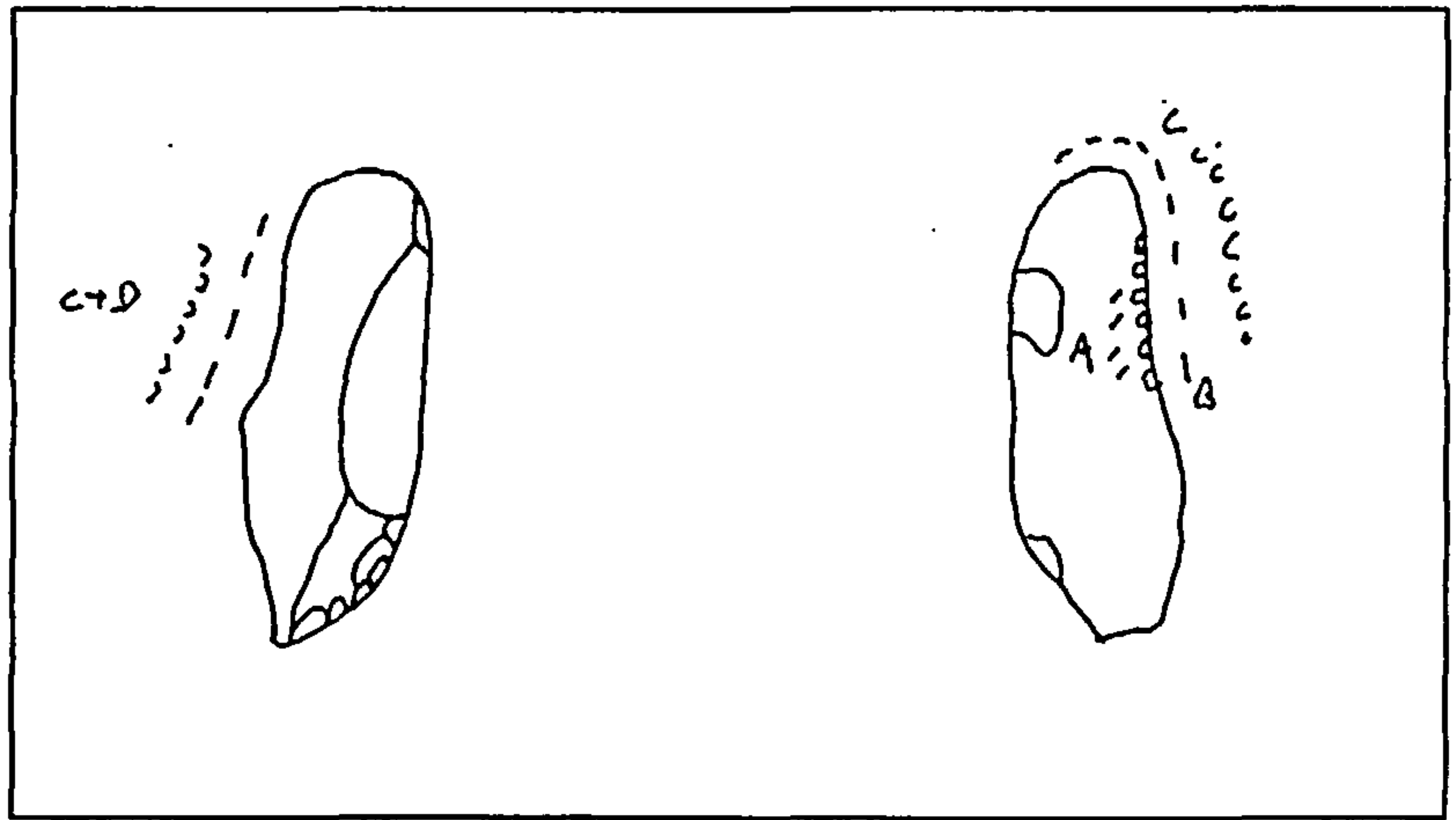
Ventral side a: frequent clustered small mostly feather terminating deep scars (going from proximal) associated with A: patchy polish away from edge. polish is smooth flat, scattered, developed, bright, with abrupt edges and occasional medium irregular pits, also with B: patchy polish on edge. Polish is smooth invasive, partially linked, with soft edges and common medium irregular pits.

Numerous other features scattered about

Interpretation: side a used. prob long motion, soft material.

Comments: A possibly PDSM effect, problems caused by many NUW

Ref: S1056
Type: ED
Blank: BLADE
Mat: FLINT
Dim: 22x11x4
Qual: MED
Cond: FRESH



Material: Grain: M Homog: H Crys: A Topo: U Fissures: C

Edge Angle: acute

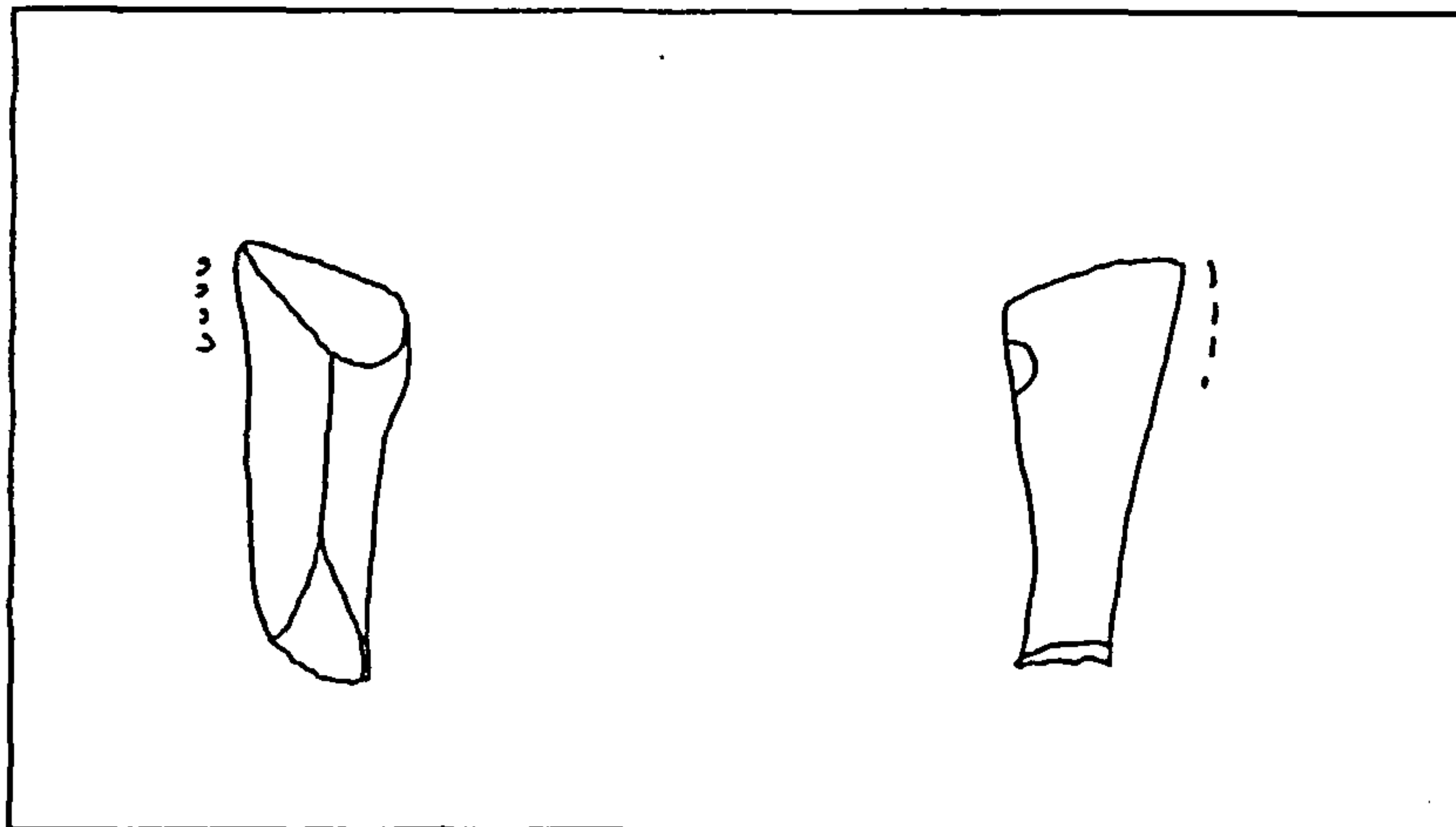
Traces:

Dorsal side a: rare scattered medium to small mostly feather terminating mostly deep scars associated with C: broad spread of polish along and away from edge. Polish is smooth invasive, partially linked, poor, variable with soft edges and no internal features. Also with D: patchy linear polish along edge. Polish is smooth reticulated, partially linked, with gradual edge and no internal features

Ventral side a: common clustered large to medium mostly feather terminating mostly deep scars, associated with A: patchy (partially linear at 45o to edge) polish away from edge. Polish is smooth domed, partially linked, variable with gradual edge and no internal features. Also with B: patchy (partially linear at 45o to edge) polish away from edge. Polish is smooth domed, partially linked, developed, variable with gradual edges and common medium circular pits. Also with polish C.

Interpretation: Side a used. probably transverse
Comments: best polish and edge damage on same face.
Linearity on ventral caused partly by tool topography

Ref: S1085
Type:
Blank: BLADE
Mat: CHERT
Dim: 22x12x7
Qual: GOOD
Cond: FRESH



Material: Grain: M Homog: V Crys: O Topo: F Fissures:
C

Edge Angle: thick

Traces:

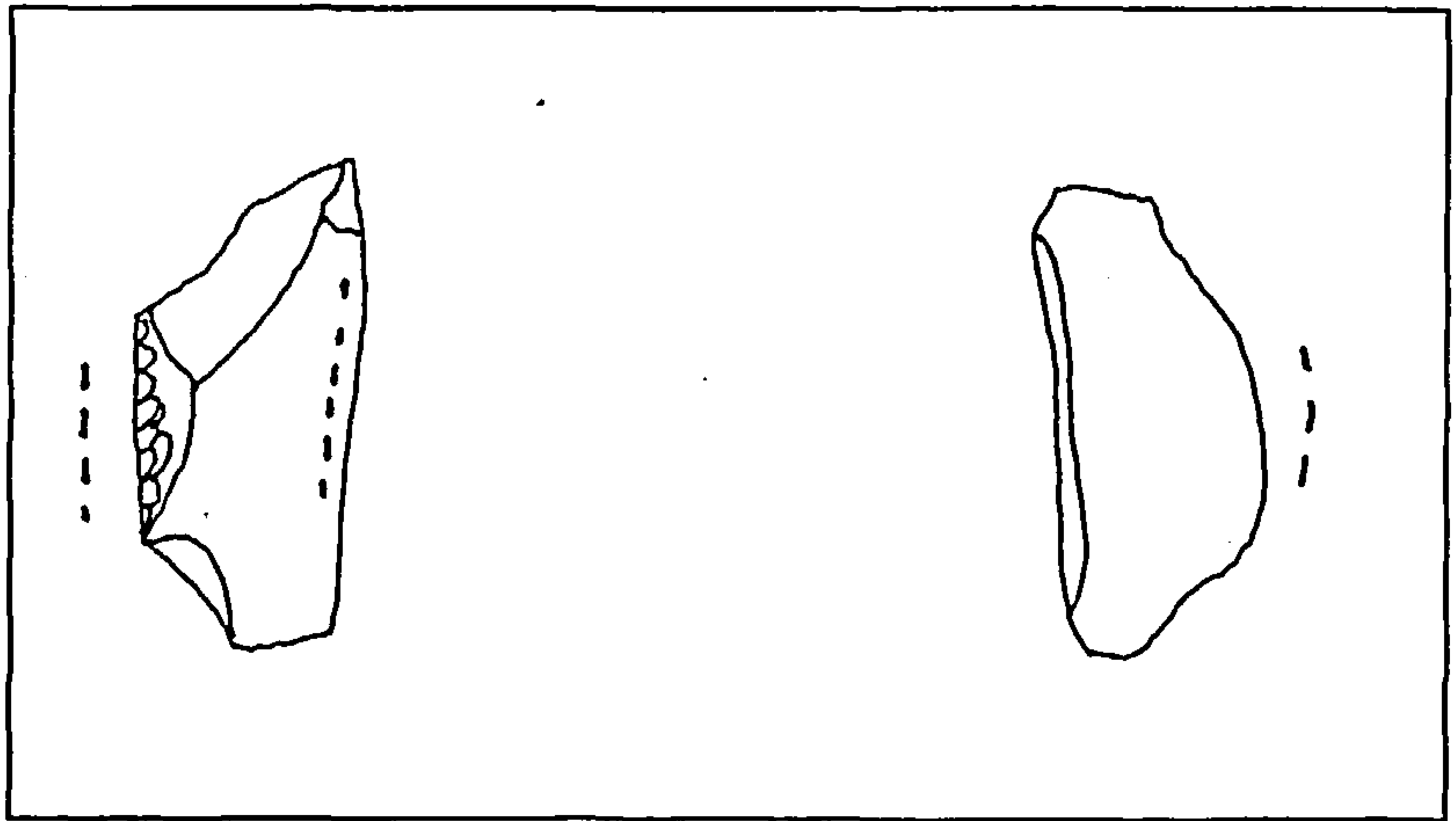
Dorsal side a: Common clustered and layered medium mostly step terminating deep scars, associated with some crushing, no polish

Ventral side a: no edge damage. Patchy polish on and away from edge. Polish is smooth (rough) reticulated, scattered, poor, with gradual edges and no internal features.

Interpretation: side a used. Transverse use, hard material, short duration

Comments:

Ref: S1088
Type: SCRAPER
Blank: FLAKE
Mat: FLINT
Dim: 27x15x8
Qual: GOOD
Cond: SP



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: thick

Traces:

edge damage not recorded as impossible because of
retouch

Dorsal side a: patchy polish along and away from
edge. Polish is smooth domed, partially linked,
developed, variable with gradual edges and
occasional medium circular pits. Occasionally has
fluid appearance.

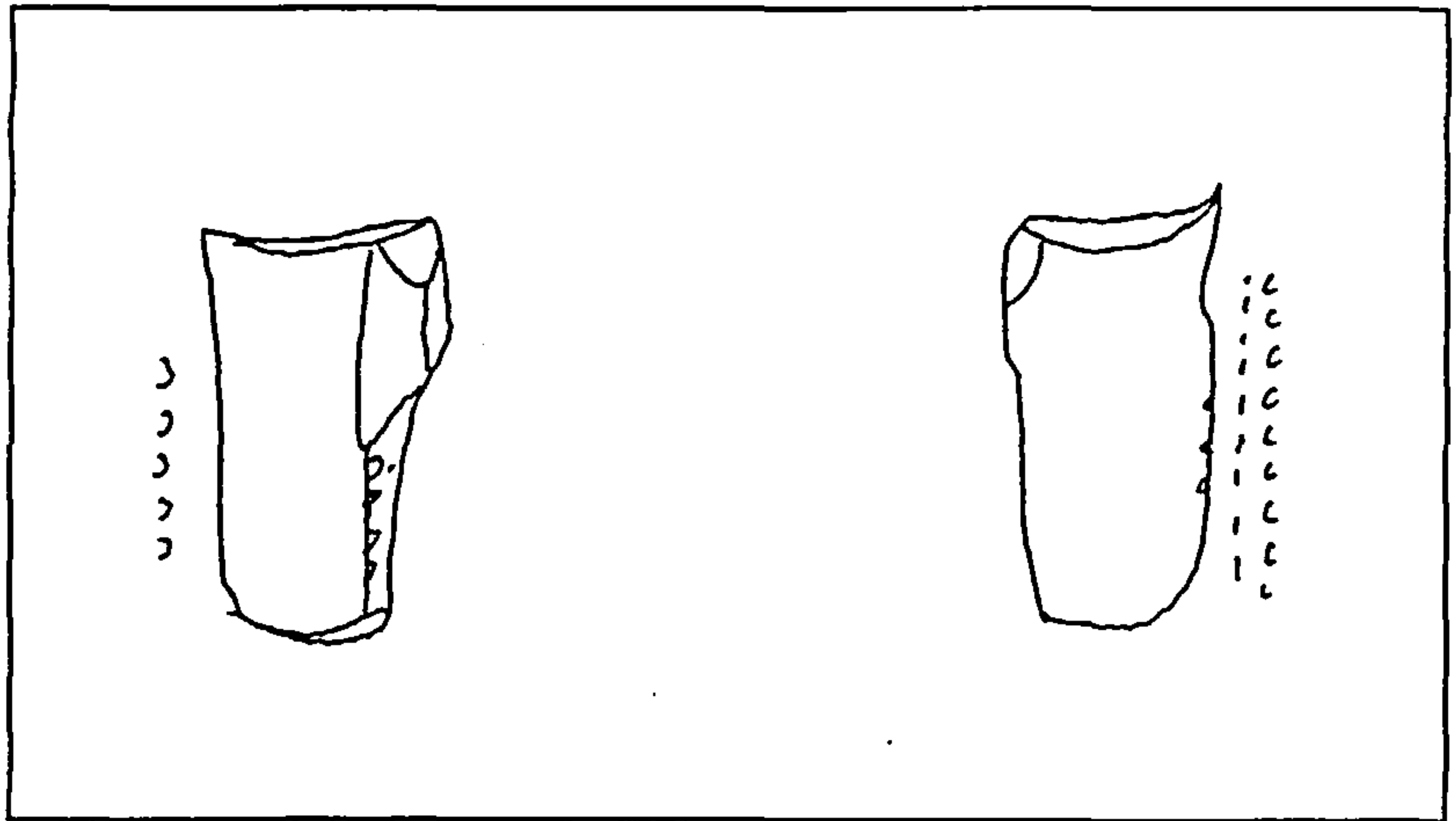
Dorsal side b: patchy polish away from edge and on
interior. Polish is smooth flat, allover, developed,
bright, with abrupt edges and common minute
irregular pits.

Ventral side a: restricted narrow linear polish
along edge. Polish is smooth domed, partially
linked, with soft edges and occasional small
irregular pits.

Interpretation: side a used, transverse?

Comments: Difficult, polish on ventral might just be the
result of retouch smear. Surface light patination causes
problems.

Ref: S1151
Type:
Blank: FLAKE
Mat: CHERT
Dim: 25x15x8
Qual: MED
Cond: SW



Material: Grain: M Homog: H Crys: C Topo: R Fissures:
C

Edge Angle: medium

Traces:

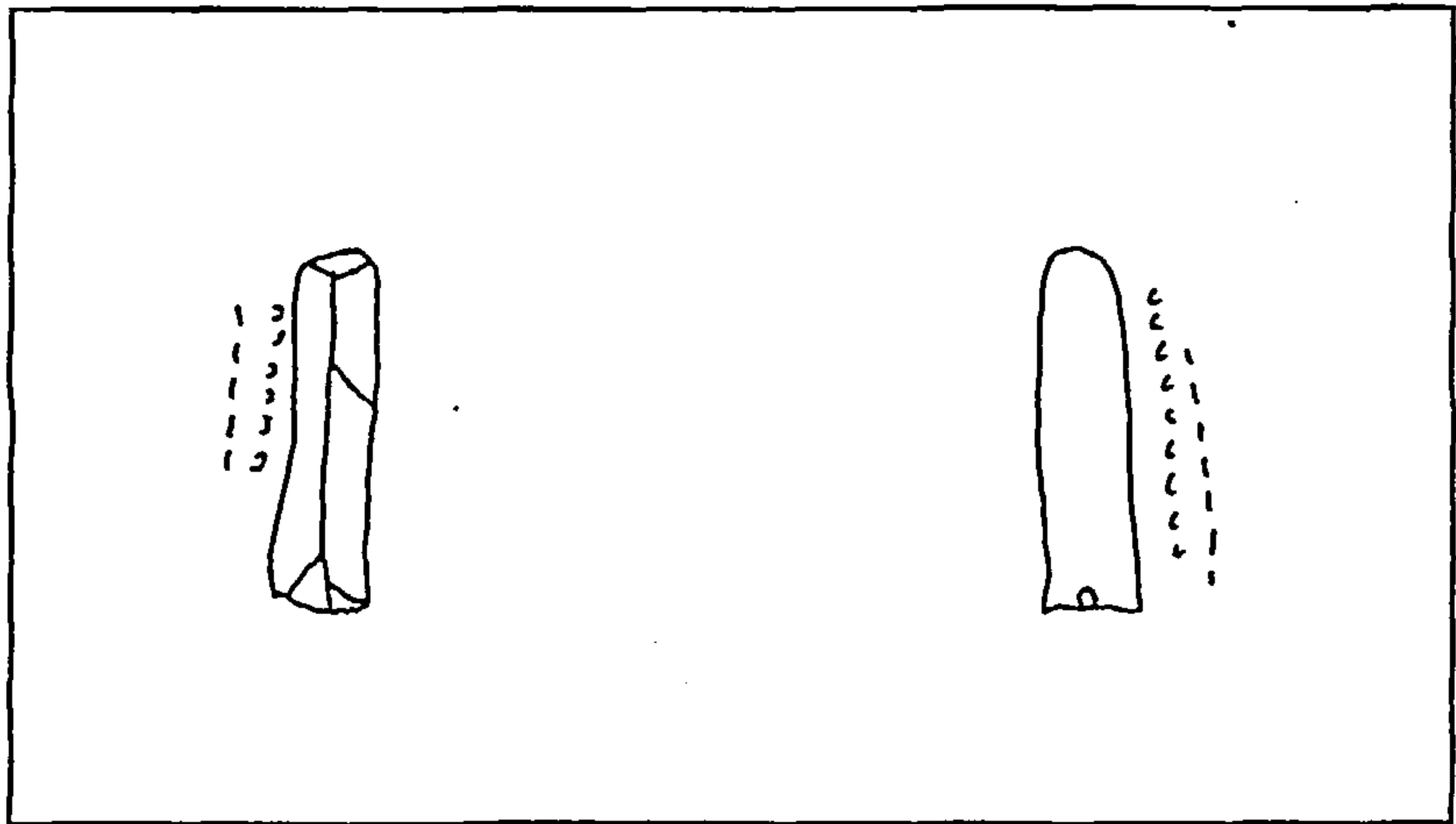
Dorsal side a: occasional clustered medium mostly step terminating mixed scars. No polish

Ventral side a: common clustered medium mostly step terminating mostly deep scars associated with a broad spread along and away from the edge. Polish is smooth domed (reticulated), partially linked, developed, with fairly gradual edges and occasional medium irregular pits.

Interpretation: used?

Comments: dorsal surface covered with crystals, cannot perceive polish. Ventral reticulation in part the result of surface topography

Ref: S1155
Type:
Blank: BLADE
Mat: FLINT
Dim: 15x6x3
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
O

Edge Angle: medium

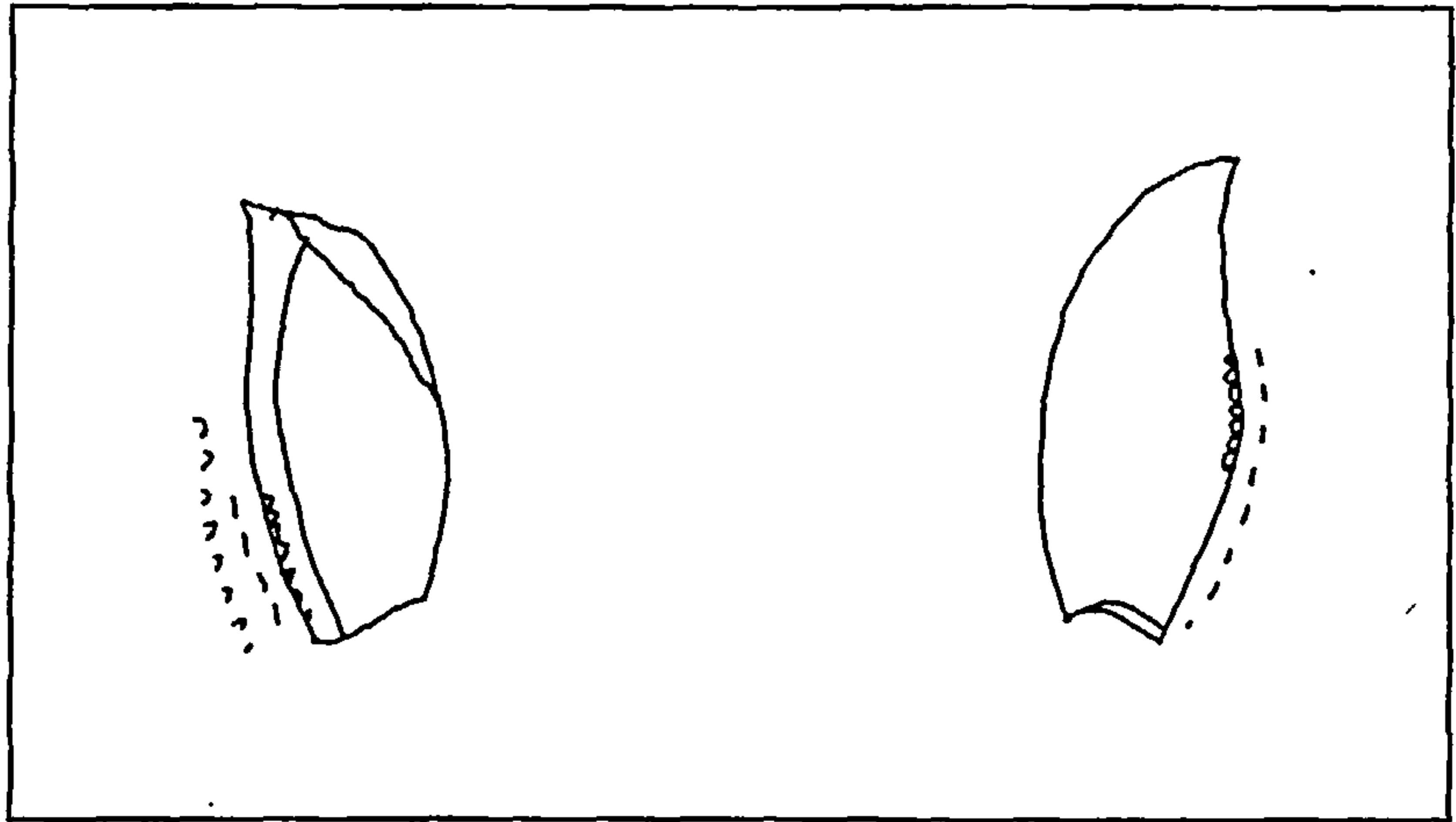
Traces:

Dorsal side a: common clustered large mixed termination deep scars associated with B: a broad spread of polish along the edge. Polish is rough reticulated, scattered, poor, variable, with gradual edges and no internal features.

Ventral side a: occasional scattered large to medium mixed terminating deep scars associated with A: patchy broad linear feature perpendicular to edge, away from edge. Polish is smooth flat (reticulated), scattered, developed, with abrupt edges and no internal features. Also with B. Also with C: restricted patchy polish along edge. Polish is smooth invasive, partially linked, with gradual edges and occasional small circular pits. Also with D: restricted patchy polish along edge. Polish is smooth domed, partially linked, with gradual edges and no internal features.

Interpretation: side a used
Comments:

Ref: S1156
Type: ED
Blank: FLAKE
Mat: CHERT
Dim: 28x16x6
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: medium

Traces:

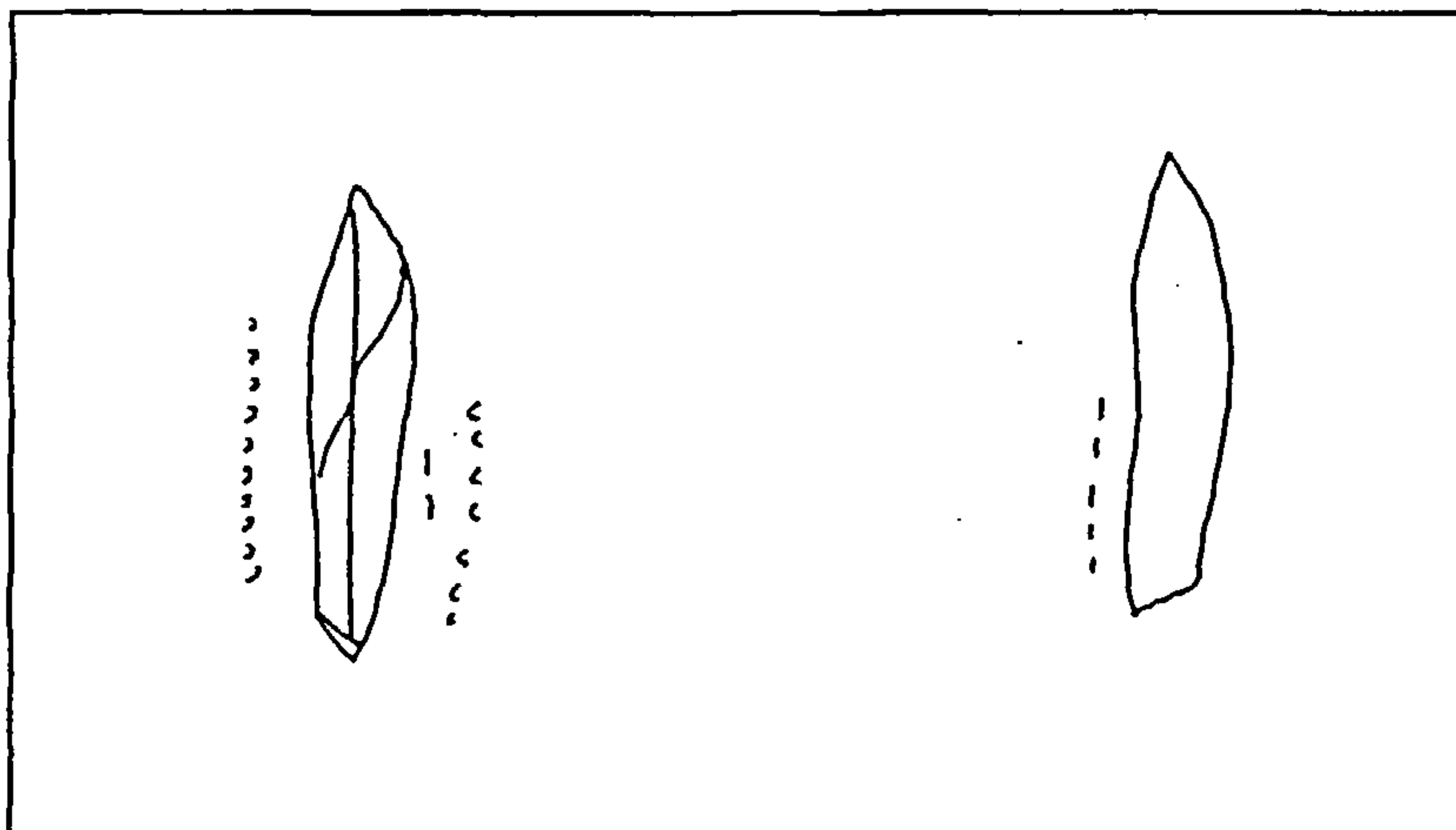
Dorsal side a: numerous clustered small step terminating deep scars, associated with a broad spread of polish along and away from the edge. Polish is widely variable, from rough reticulated to smooth domed, partially linked, developed, with fairly sharp edges and occasional to frequent variable circular pits.

Ventral side a: common clustered small step terminating deep scars, associated with a broad spread of polish along and away from the edge. Polish is widely variable, from rough reticulated to smooth domed, partially linked, developed, with fairly sharp edges and occasional to frequent variable circular pits.

Interpretation: side a prob used

Comments: polish almost certainly includes a NUW/PDSM element. Makes detailed interpretation impossible

Ref: S1157
Type:
Blank: BLADE
Mat: CHERT
Dim: 17x5x2
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
O

Edge Angle: thick

Traces:

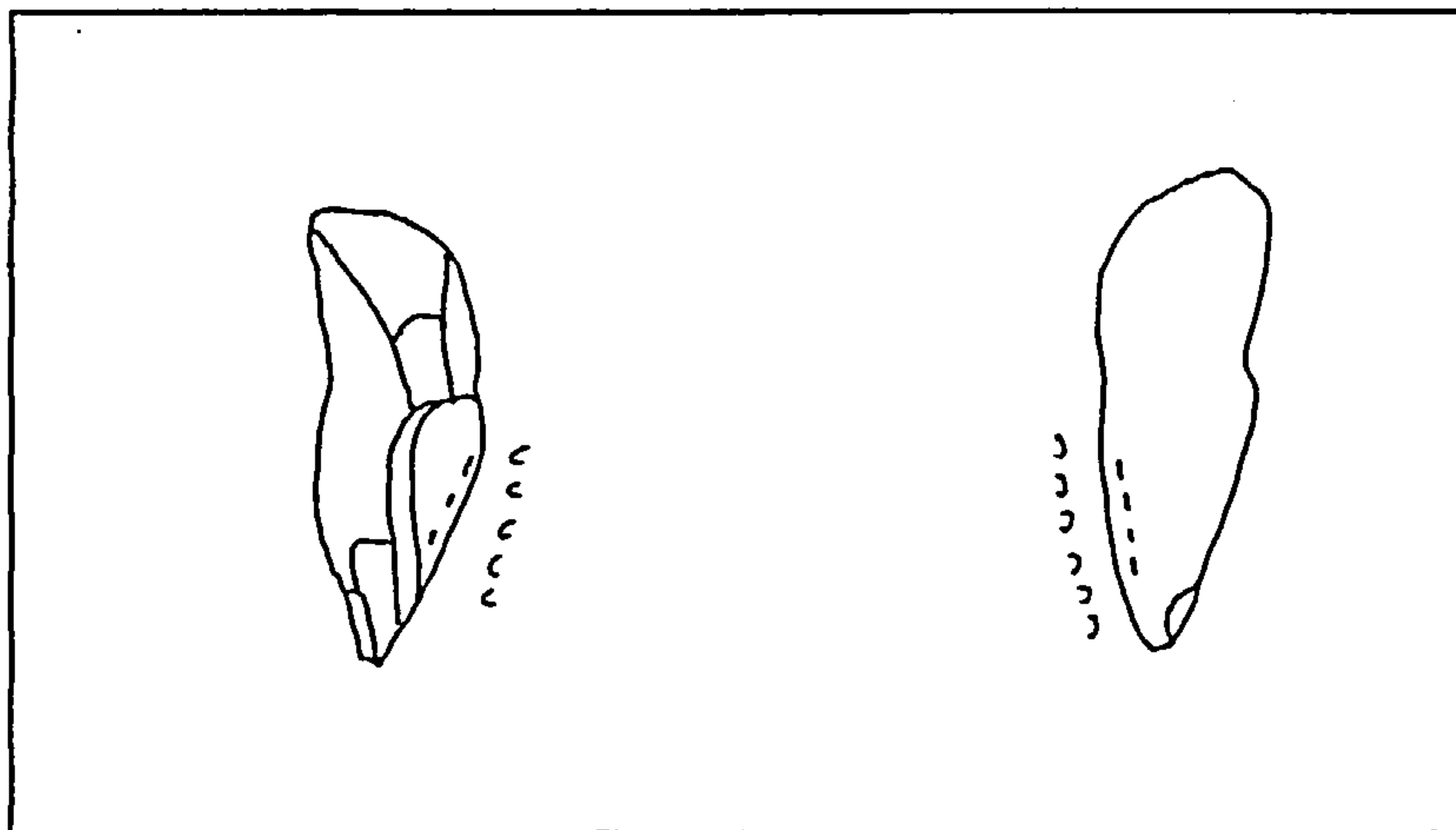
Dorsal side b: frequent clustered small mostly step terminating deep scars, associated with restricted patches of polish away from the edge. Polish is smooth reticulated, allover, developed with sharp edges and common variable circular pits.

Ventral side b: no edge damage. Linear polish along edge. Polish is smooth invasive partially linked, with fairly sharp edges and no internal features.

Dorsal side a: common clustered minute mostly step terminating deep scars.

Interpretation: side b used. transverse, ventral leads.
Comments: side a = hafting?

Ref: S1159
Type:
Blank: BLADE
Mat: CHERT
Dim: 21x10x7
Qual: MED
Cond: FRESH



Material: Grain: F Homog: V Crys: O Topo: R Fissures:
O

Edge Angle: medium

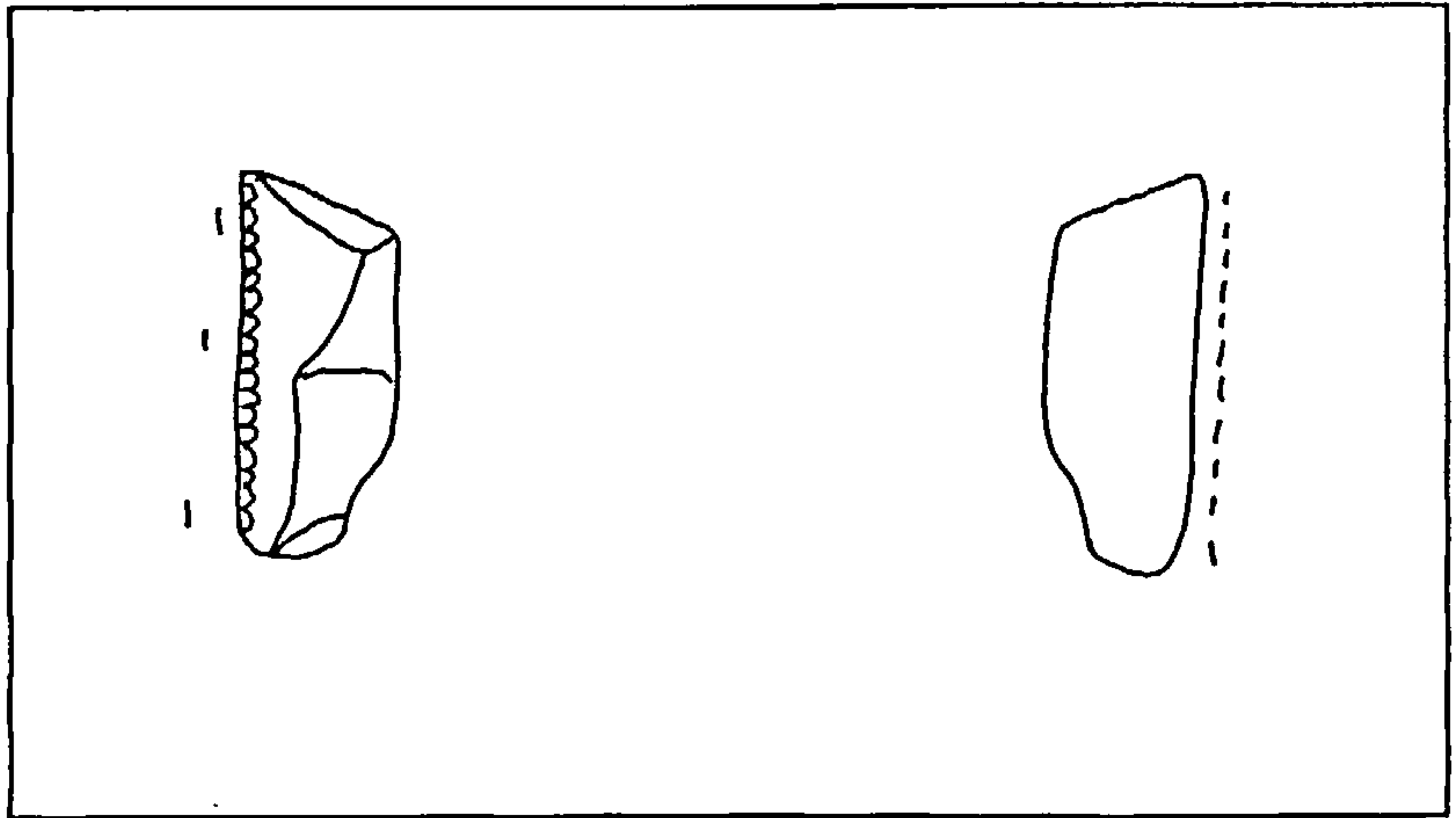
Traces:

Side b, both faces nearly identical: frequent clustered and layered large to medium mixed terminating deep scars associated with a restricted patchy polish away from edge. Polish is smooth reticulated, partially linked, with sharp edges and no internal features.

Interpretation: side b used, prob long motion, hard material

Comments: no significant polish. ID based on edge damage

Ref: S1162
Type:
Blank: BLADE
Mat: CHERT
Dim: 20x10x3
Qual: GOOD
Cond: FRESH



Material: Grain: M Homog: H Crys: A Topo: F Fissures:
A

Edge Angle: thick

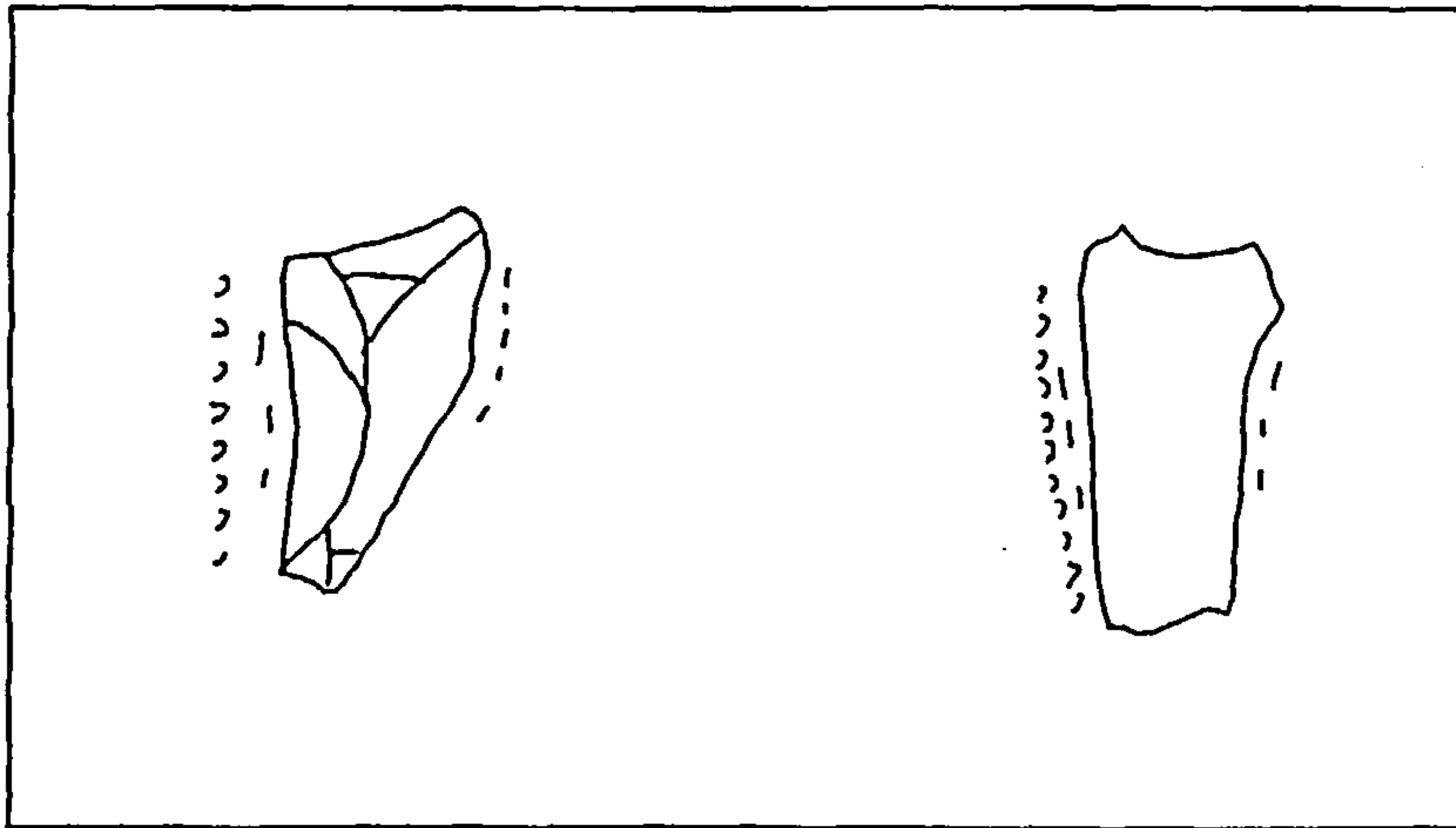
Traces:

Dorsal side a: edge damage impossible because of retouch. Patchy polish along edge. Polish is smooth domed, partially linked, with gradual edges and no internal features.

Ventral side a: no edge damage. Broad spread of polish along edge. Polish is smooth domed and invasive, partially linked, variable with gradual edges. Also patches along edge of smooth domed, allover, developed polish with gradual edges and common minute circular pits.

Interpretation: side a used, transverse motion
Comments:

Ref: S1163
Type:
Blank: FLAKE
Mat: CHERT
Dim: 21x11x4
Qual: MED
Cond: FRESH



Material: Grain: M Homog: H Crys: O Topo: F Fissures:
O

Edge Angle: side a: thick, side b: medium

Traces:

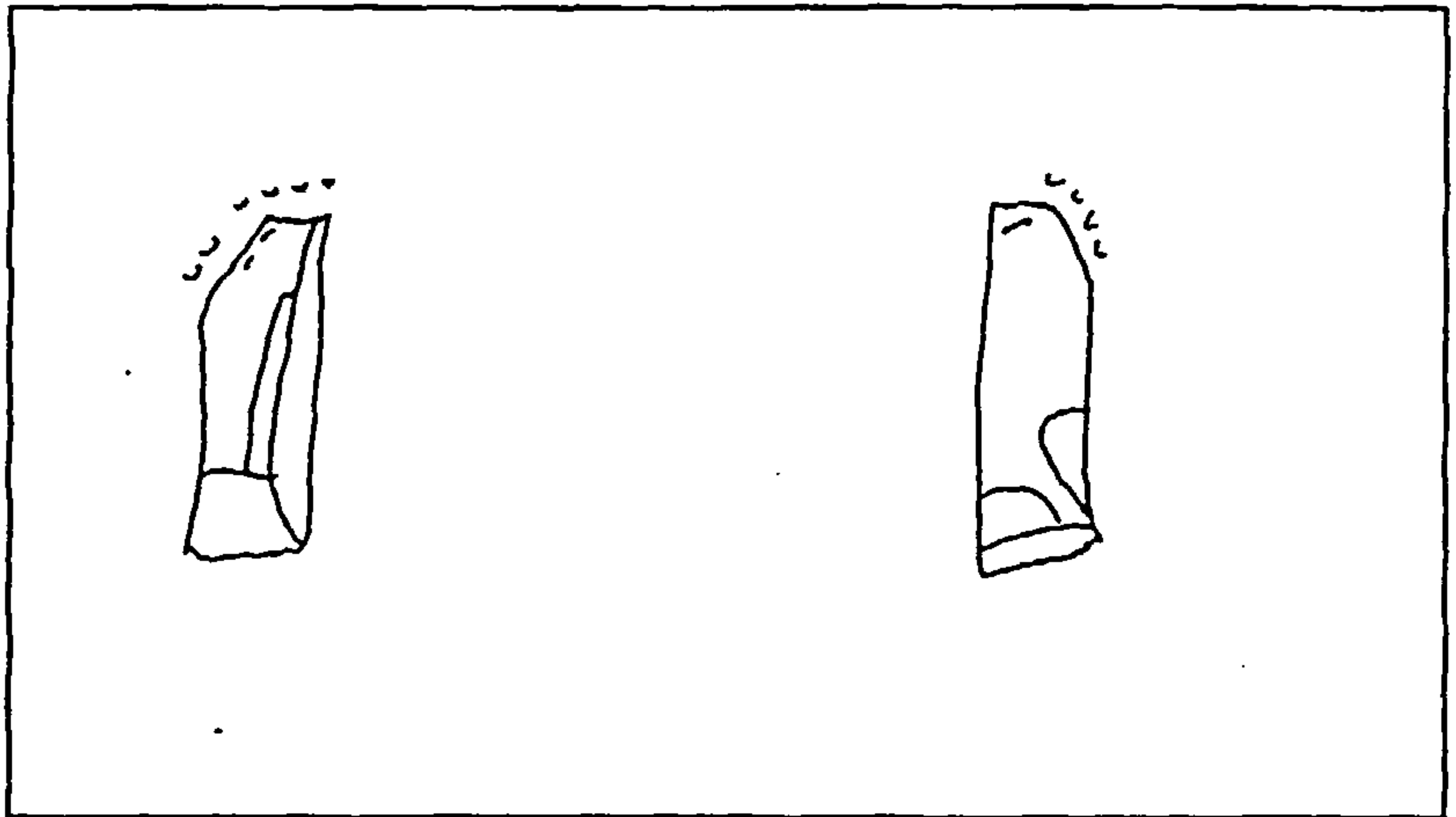
Dorsal side a and ventral side b: Occasional to common clustered and layered medium step terminating deep scars, associated with restricted patchy polish along edge. Polish is smooth domed, partially linked, with soft edges and occasional small irregular pits.

Dorsal side b and ventral side a: no edge damage. Restricted patchy and narrow linear polish along edge. Polish is smooth domed, allover, with sharp edges and no internal features. Also some polish as above.

Interpretation: Both sides used, transverse motions, turned over between uses.

Comments: Notes above simplify situation a little.

Ref: S1165
Type:
Blank: BLADE
Mat: CHERT
Dim: 15x7x4
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: medium

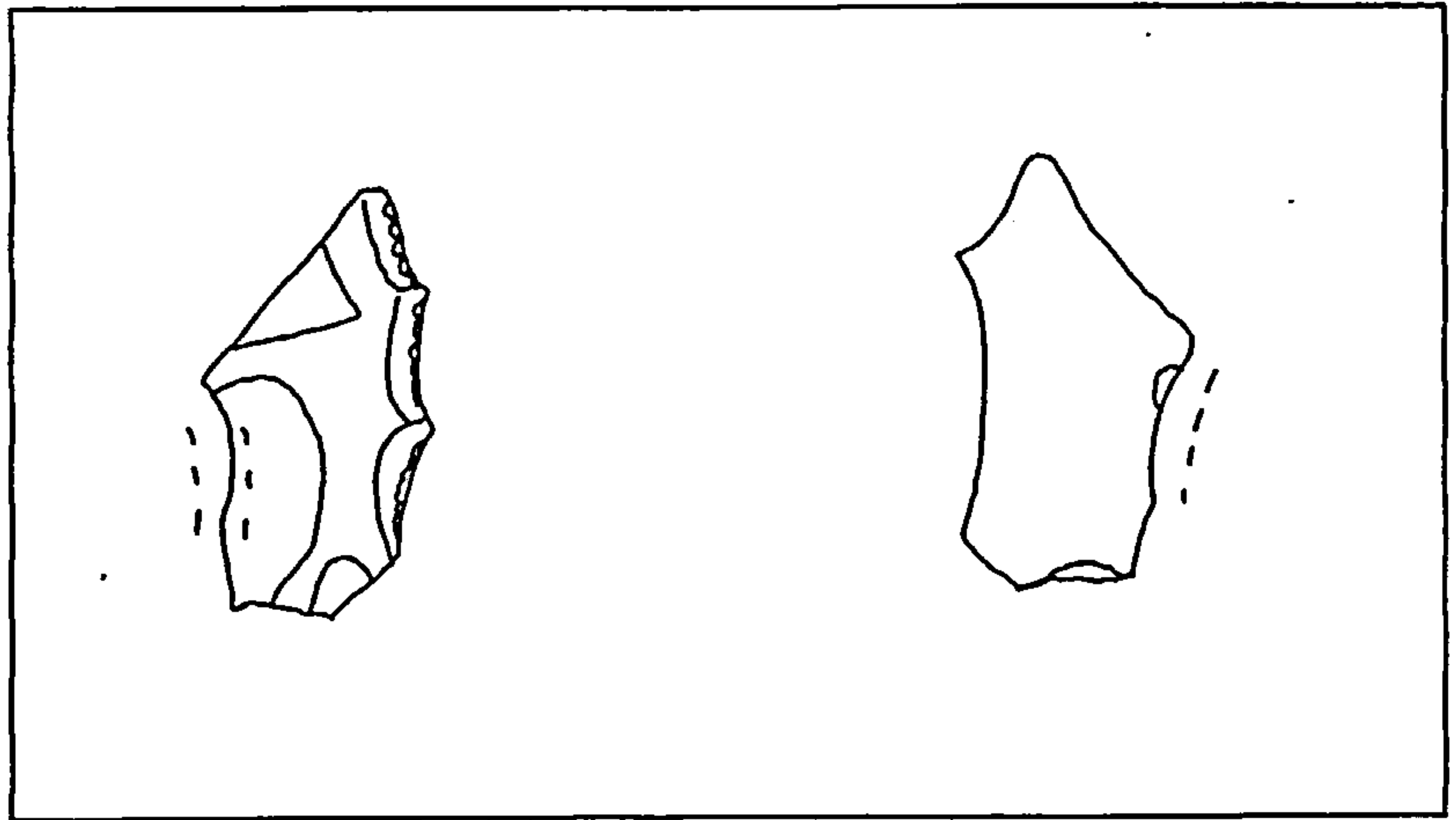
Traces:

Dorsal side a: common to frequent clustered medium mixed termination deep scars with snaps, associated with a restricted patchy polish away from edge. Polish is smooth domed, partially linked, with gradual edges and numerous small to minute circular pits.

Ventral side a: common clustered medium mostly step terminating deep scars with snaps, associated with a broad patch of polish away from edge. Polish is smooth domed, partially linked, developed, bright, with gradual edges and no internal features. Has a general linear distribution.

Interpretation: Corner of side a and distal end used.
Long motion, fairly hard material, grooving
Comments: good evidence.

Ref: S1167
Type:
Blank: FLAKE
Mat: CHERT
Dim: 25x13x5
Qual: MED
Cond: SW



Material: Grain: C Homog: H Crys: O Topo: F Fissures:
O

Edge Angle: medium

Traces:

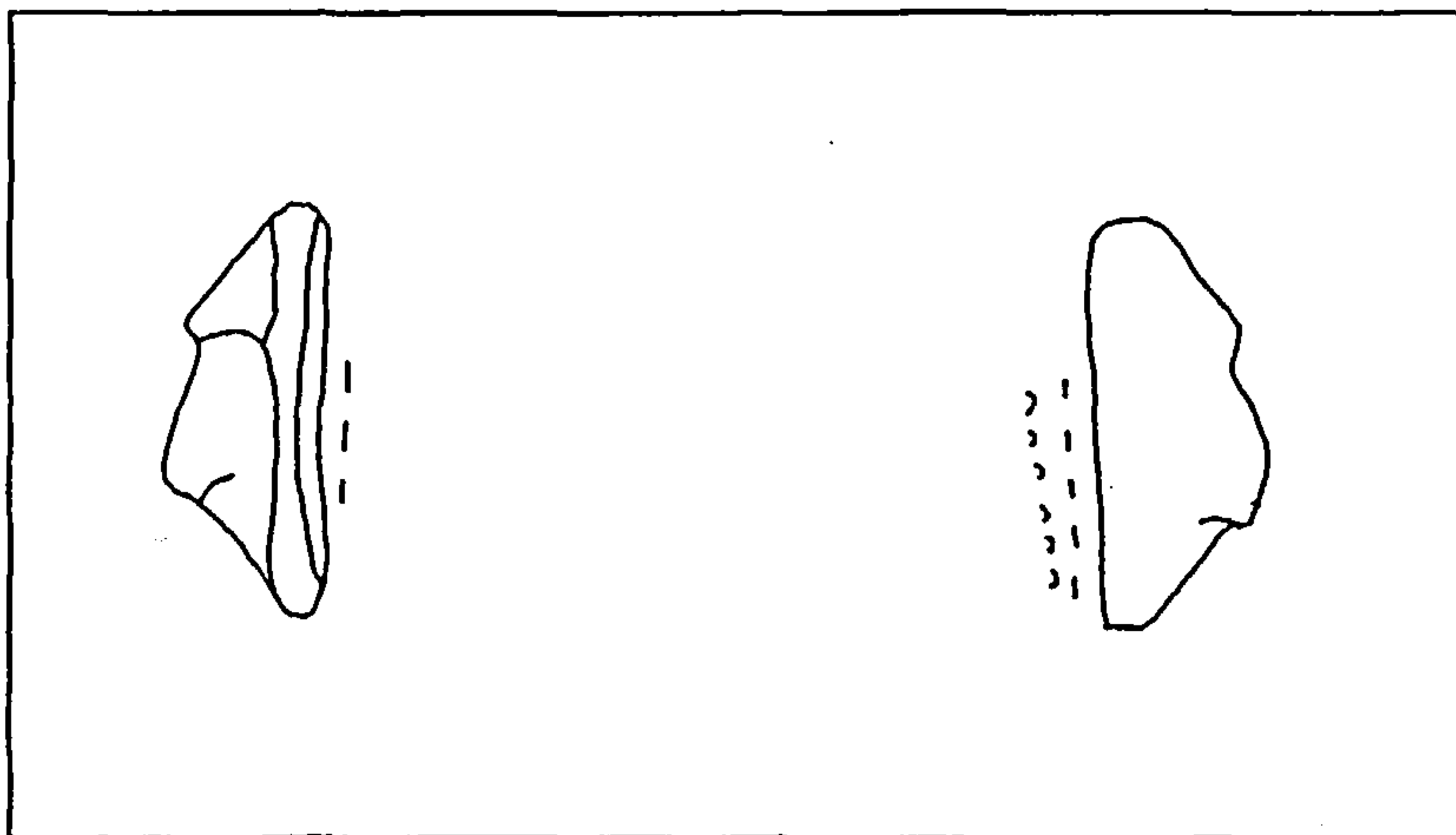
Dorsal side a: No edge damage. Restricted patchy polish. Polish is smooth domed, all over, developed, with sharp edges and frequent small circular pits. Also patchy restricted polish away from edge. Smooth flat, partially linked, with abrupt edges and occasional small irregular pits.

Ventral side a: As dorsal, but no polish away from edge

Interpretation: Pos opp use of side a.

Comments: No use of retouched side, opp use of sharp edge. Very patchy and unconvincing, but rest of piece fresh.

Ref: S1169
Type:
Blank: BLADE
Mat: CHERT
Dim: 28x12x3
Qual: MED
Cond: FRESH



Material: Grain: M Homog: H Crys: O Topo: F Fissures: A

Edge Angle: thick

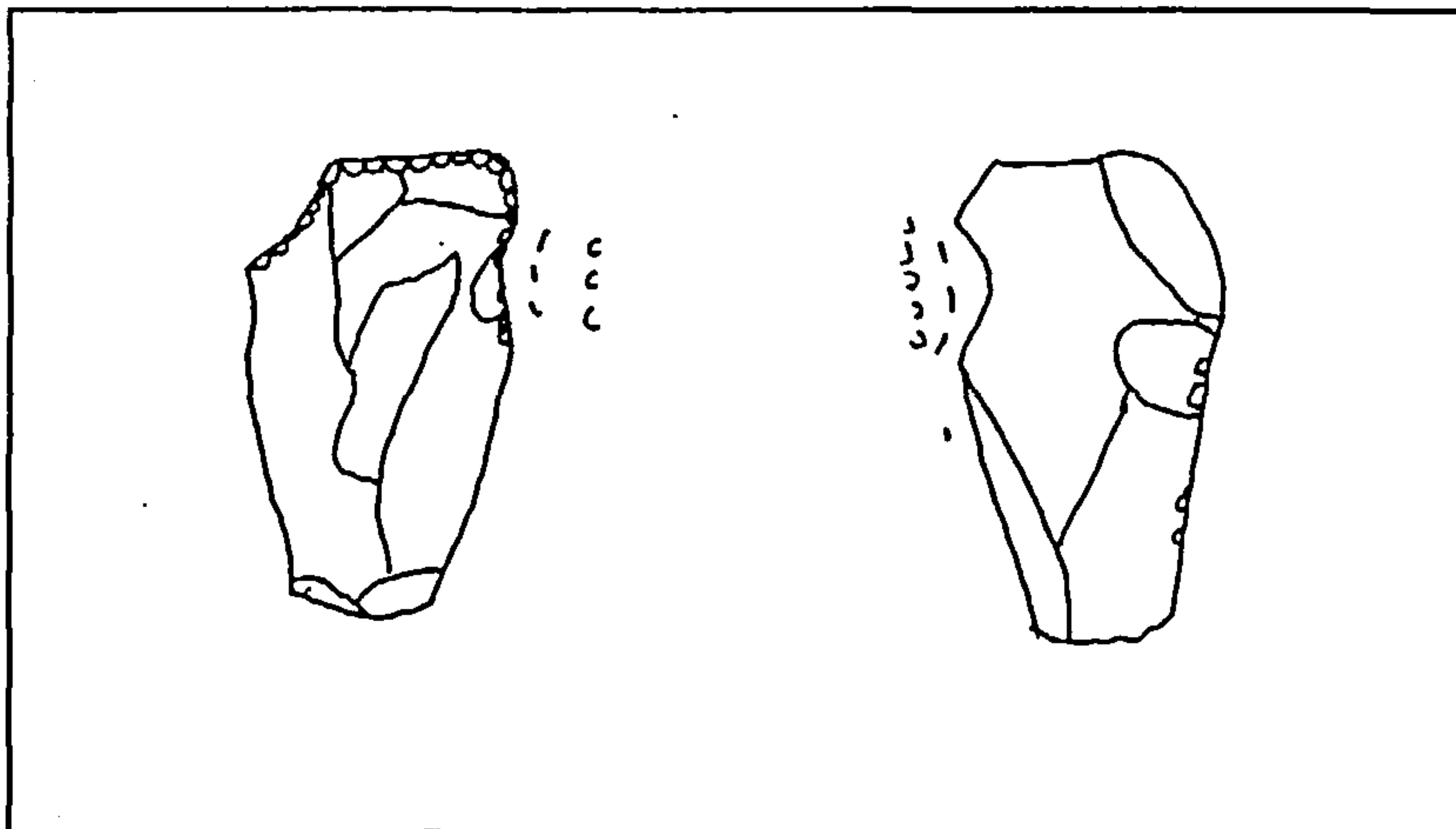
Traces:

Ventral side b: rare clustered large mostly feather terminating deep scars, associated with A: patchy polish on edge. Polish is smooth flat reticulated, partially linked, developed, with gradual edges and frequent variable irregular pits. Also B: Patchy polish on edge. Polish is smooth invasive, allover, fairly sharp edges, no internal features. Also C: (In B) restricted patchy polish on edge. Polish is smooth flat, partially linked, developed with gradual edges and rare medium irregular pits.

Dorsal side b: Polish B and D: patchy polish along edge, polish is smooth domed, allover, developed, with gradual edges and rare large irregular pits. Some edge bevel.

Interpretation: side b used, transverse, ventral lead
Comments: very difficult as dorsal edge is a crystal plane. Edge too thick for longitudinal use.

Ref: S1170
Type: SCRAPER
Blank: FLAKE
Mat: CHERT
Dim: 32x20x14
Qual: MED
Cond: FRESH



Material: Grain: F Homog: V Crys: C Topo: F Fissures:
0

Edge Angle: thick

Traces:

Dorsal side b: occasional clustered medium mostly step terminating deep scars. Associated with patchy spread of polish along and away from edge. Polish is smooth invasive (reticulated), partially linked, variable, with gradual edges and occasional small irregular pits.

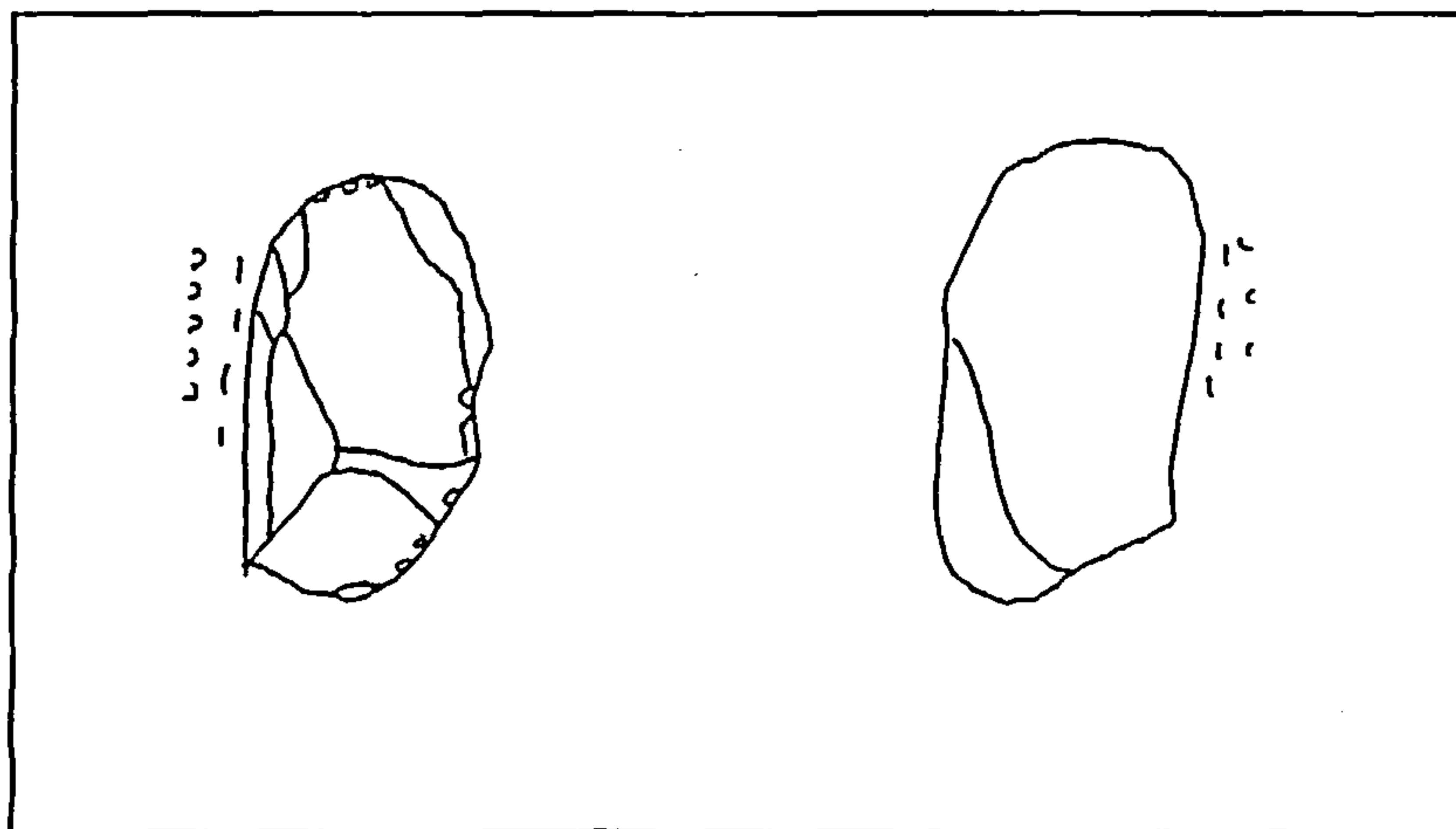
Ventral side b: frequent clustered and layered medium to small mostly step terminating mostly deep scars, associated with A: patchy polish on edge. Polish is smooth domed, all over, developed, bright, with sharp edges and occasional large irregular pits. Forms bevel. Also with B: patchy polish on and away from edge. Polish is smooth flat (reticulated), partially linked, developed, bright, with sharp edges and occasional small irregular pits.

Some patchy polish at distal end

Interpretation: side b used (notch). transverse, motion through notch

Comments: again edge damage and polish predominantly on the same face.

Ref: S1171
Type: ED
Blank:
Mat: CHERT
Dim:
Qual: MED
Cond: FRESH



Material: Grain: M Homog: V Crys: C Topo: F Fissures:
0

Edge Angle: thick

Traces:

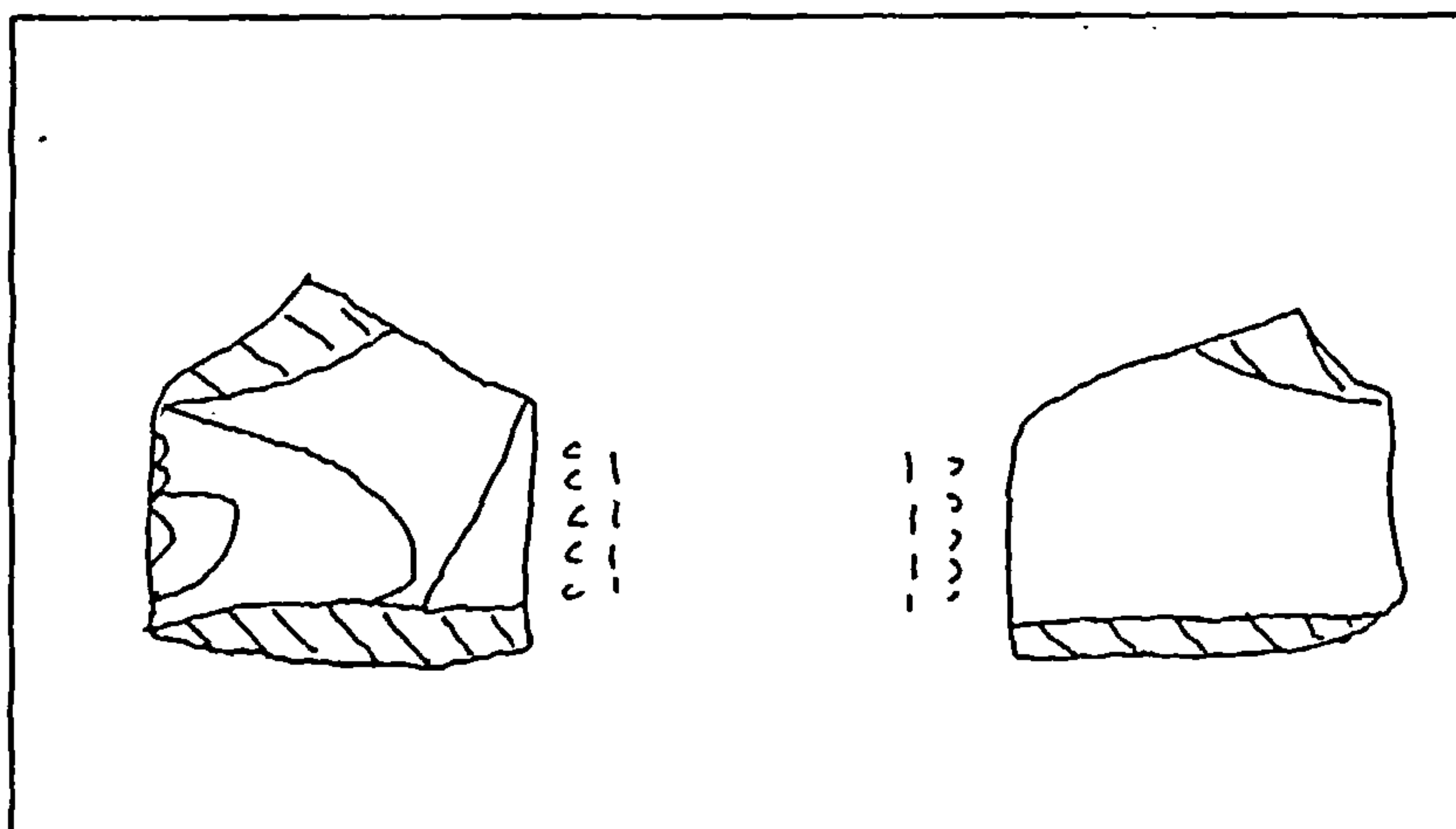
Dorsal side a: occasional clustered large mixed termination mixed scars, appear bidirectional, associated with patchy polish on edge. Polish is smooth domed (reticulated), partially linked, with gradual edges and occasional small irregular pits.

Ventral side a: marginal edge damage, some polish as on dorsal, also restricted patchy polish on edge. Polish is rough reticulated, partially linked, with sharp edges and occasional medium irregular pits.

Interpretation: Side a used, marginal. Long motion, pos bidirectional

Comments: Bifacial polish, unifacial scarring, but with directionality

Ref: S1196
Type: SCALAR
Blank: CORE
Mat: CHERT
Dim: 24x26x8
Qual: MED
Cond: FRESH



Material: Grain: M Homog: H Crys: C Topo: F Fissures:
O

Edge Angle: medium

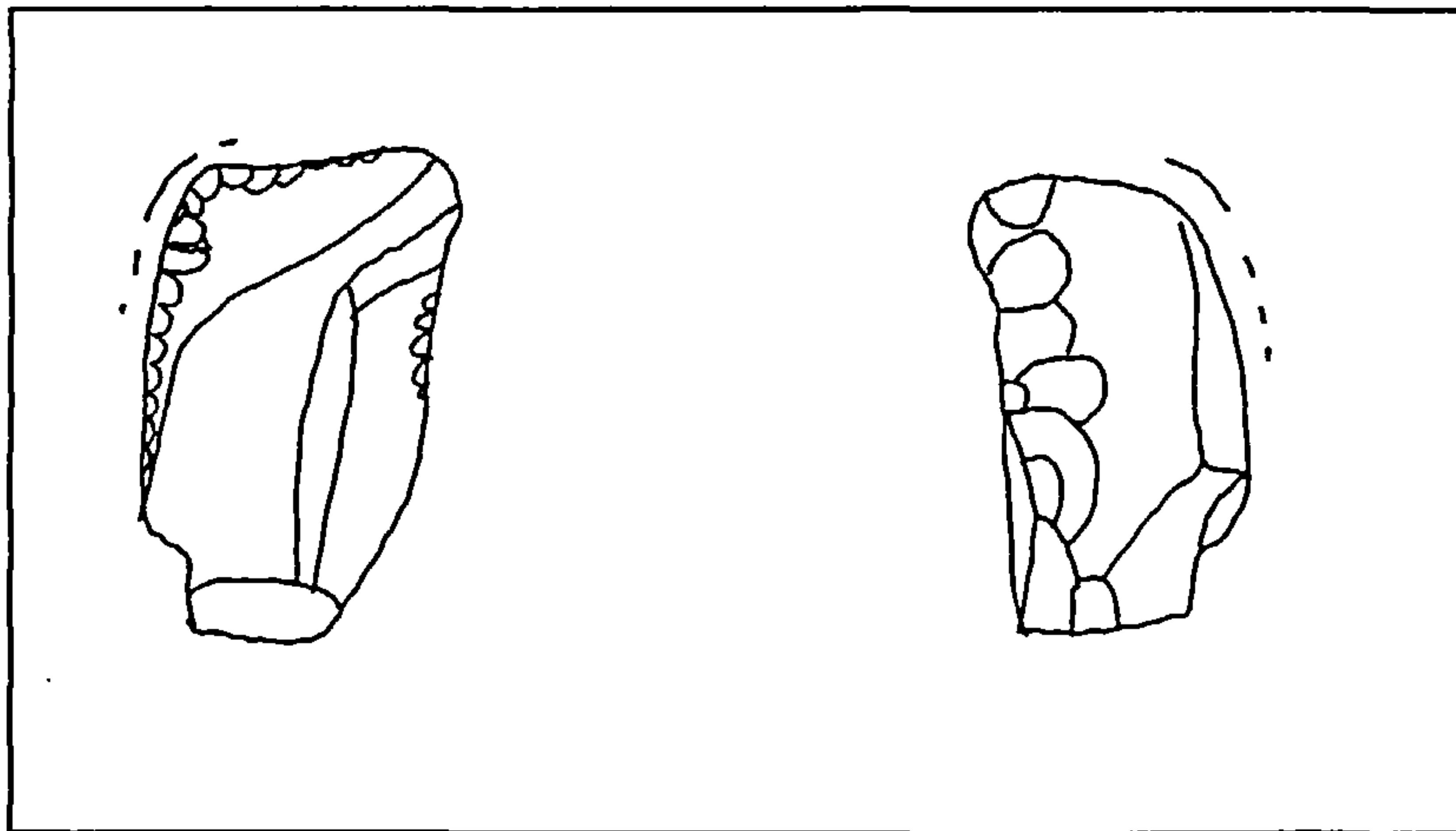
Traces:

Side a, both faces: frequent scattered large to medium mostly feather terminating deep scars, associated with broad patchy spread of polish along and away from edge. Polish is smooth flat reticulated, partially linked, with gradual edges and occasional medium irregular pits. Associated are parallel short deep narrow common striations.

Interpretation: side a used. long motion. med soft material??

Comments: not connected to core function. Many other traces clearly techno.

Ref: S1212
Type: SCRAPER
Blank: FLAKE
Mat: CHERT
Dim: 31x20x7
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: C Topo: F Fissures: C

Edge Angle: thick

Traces:

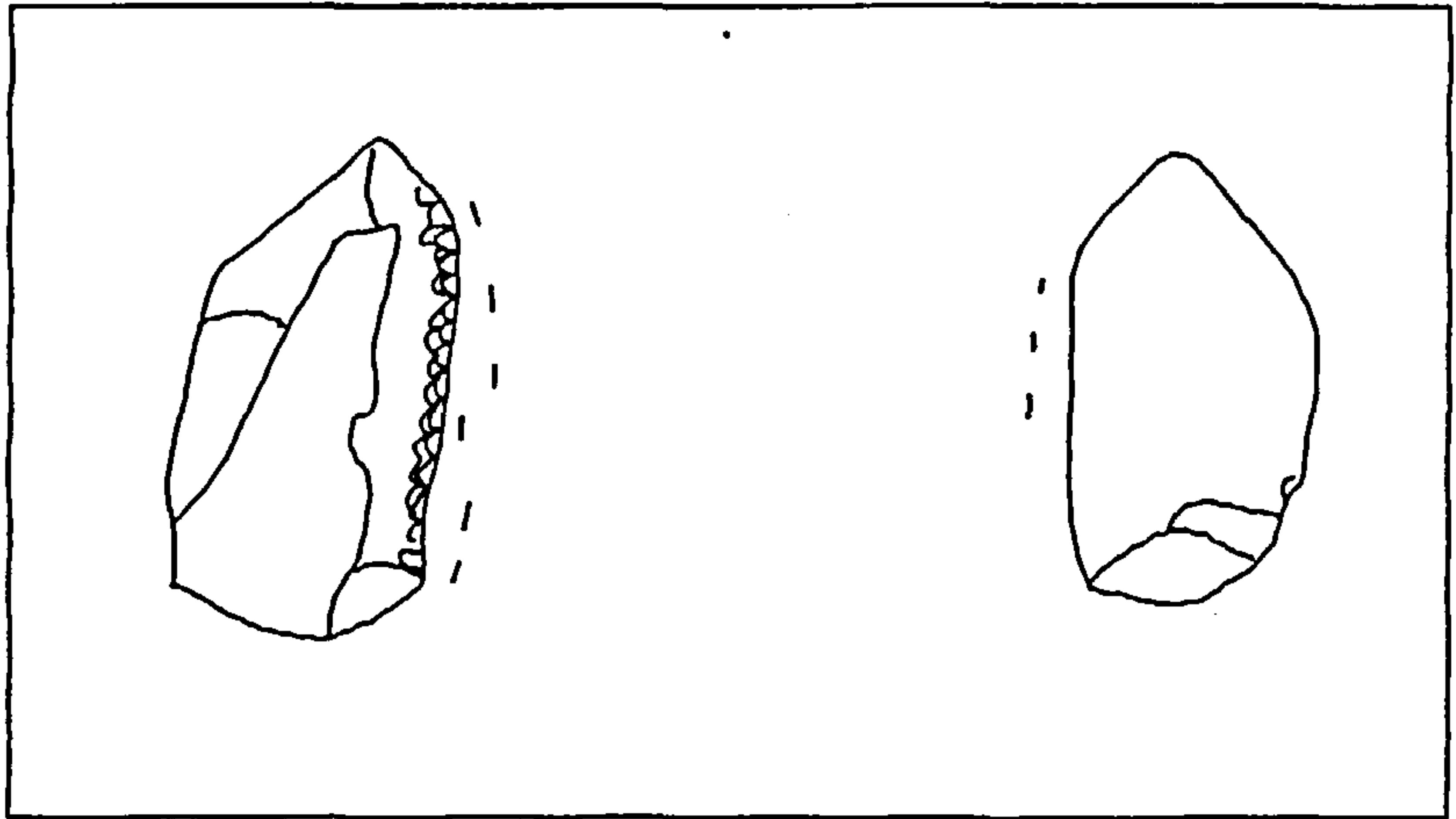
edge damage not recorded because of retouch

Side a, dorsal and ventral faces: Polish A: patchy broad spread along edge, away from edge and onto interior face. Polish is smooth domed (invasive), partially linked, developed, variable, with gradual edges and common medium circular pits. Polish B: patchy broad spread away from edge. Polish is rough reticulated, partially linked, with gradual edges and no internal features.

Interpretation: side a used. long motion, deep penetration

Comments: Difficult, very diffuse, some NUW features.

Ref: S1254
Type: SCRAPER
Blank: FLAKE
Mat: FLINT
Dim: 30x23x13
Qual: POOR
Cond: FRESH



Material: Grain: M Homog: V Crys: O Topo: R Fissures: C

Edge Angle: thick

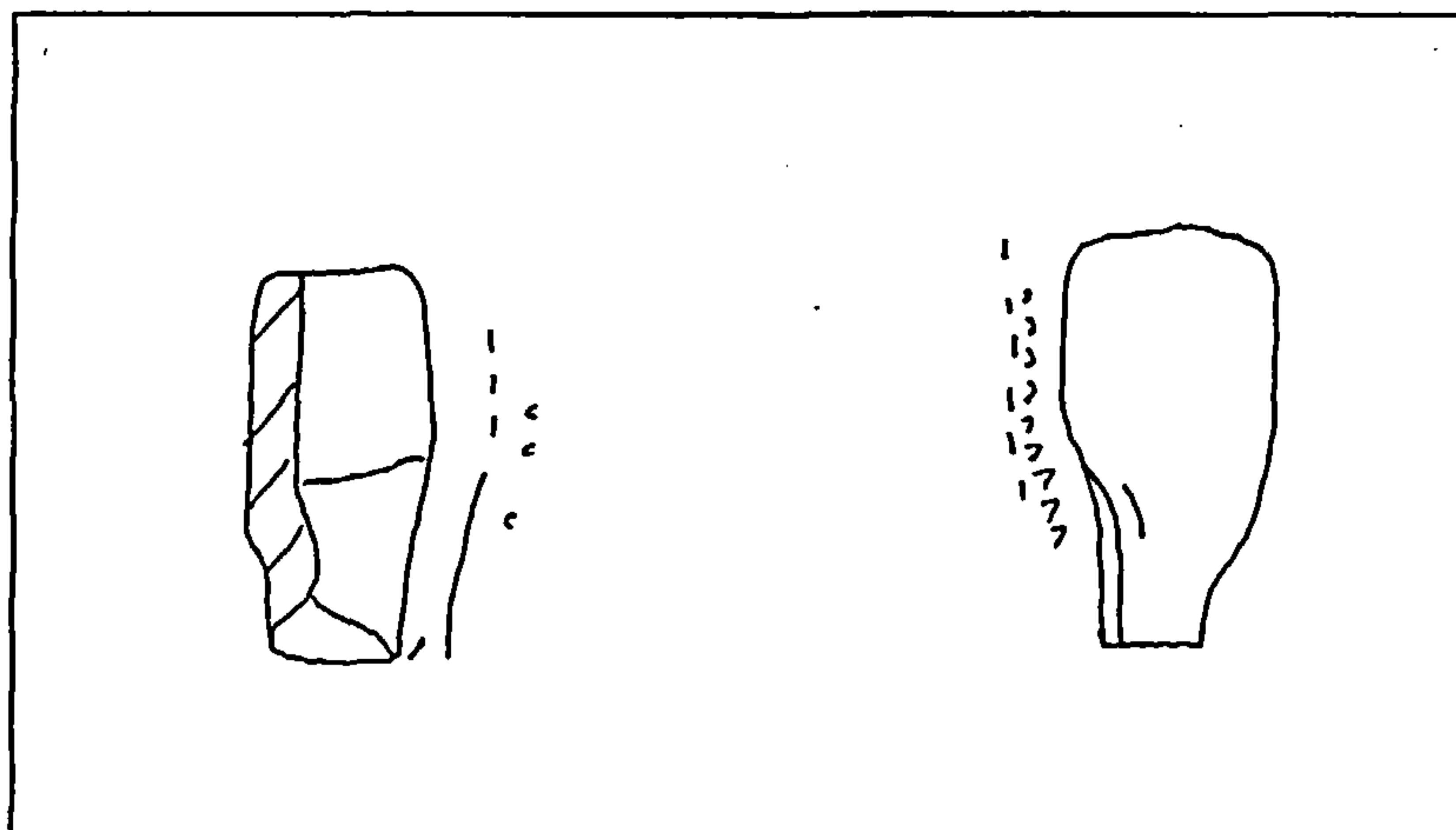
Traces:

Dorsal side b: edge damage not noted due to retouch. Polish A: restricted patches along and away from edge. Polish is smooth domed, allover, intense, bright, with sharp edges and frequent medium to small circular pits. Polish B: patchy narrow linear polish along scar ridges. Polish is smooth domed, partially linked, developed, with sharp edges and no internal features.

Ventral side b: no edge damage. Restricted patchy polish along and away from edge. Polish is smooth, flat, scattered, developed, with abrupt edges and occasional medium irregular pits.

Interpretation: side b used. probably transverse use.
Deeply invasive polish = soft material
Comments:

Ref: S1270
Type: ED
Blank: FLAKE
Mat: FLINT
Dim: 25x15x6
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures: A

Edge Angle: medium

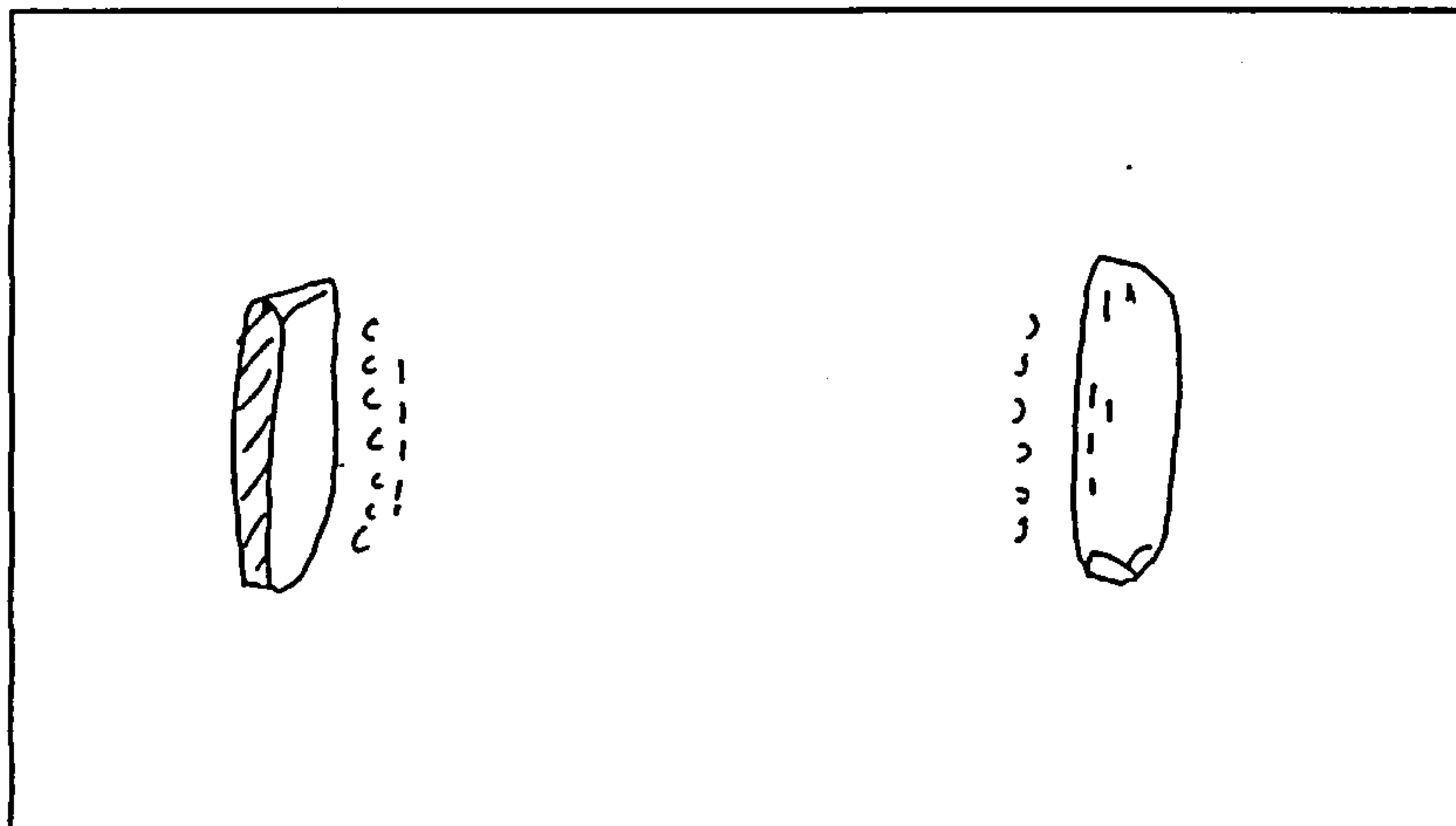
Traces:

Dorsal side b: occasional scattered medium mostly feather terminating mostly shallow scars associated with C: patchy polish along edge. polish is rough reticulated, partially linked, with soft edges and common medium irregular pits. Also D: restricted narrow linear polish along edge. Polish is rough reticulated (domed), with sharp edges and common medium irregular pits. Also E: restricted patches away from edge. Polish is smooth domed, allover, developed, bright, with abrupt edges and occasional small irregular pits. Associated are perpendicular and 75o medium deep narrow striations.

Ventral side b: frequent clustered and layered medium to small mostly step terminating deep scars, associated with A: restricted patches away from edge. Polish is smooth domed, scattered, developed, with abrupt edges and no internal features. Also with B: restricted narrow linear feature away from edge along parallel ridge. polish is smooth domed, partially linked, developed, variable, with sharp edges and occasional small irregular pits. Associated are perpendicular short deep fine striations. Also with polish C.

Interpretation: side b used. transverse motion. dorsal leading. Thick part of edge like burin edge used.
Comments:

Ref: S1291
Type: ED
Blank: BLADE
Mat: FLINT
Dim: 17x7x4
Qual: GOOD
Cond: BURNT



Material: Grain: F Homog: H Crys: A Topo: F Fissures: A

Edge Angle: medium

Traces:

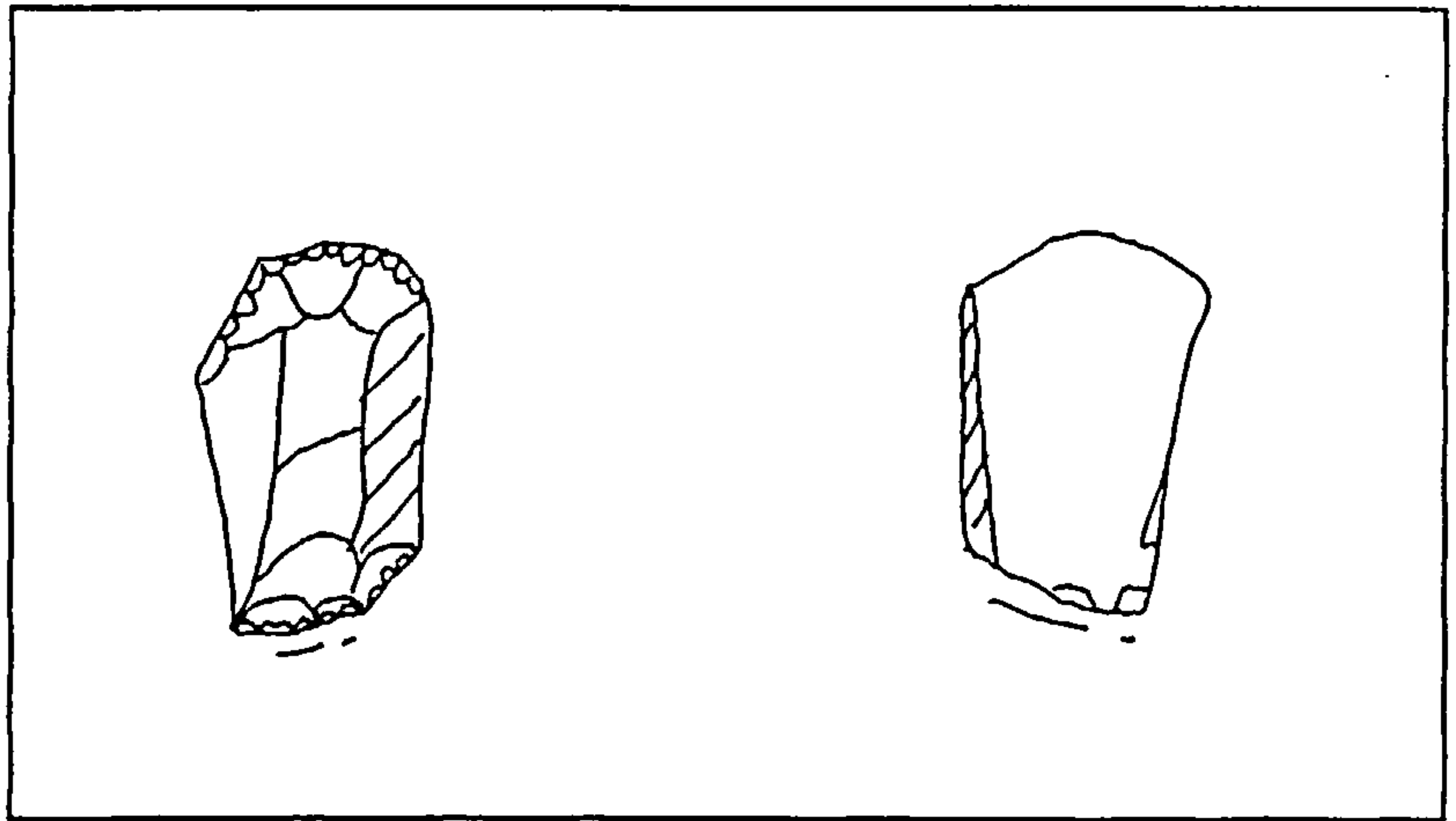
Dorsal side b: frequent to numerous clustered and layered medium to small mixed termination mostly deep scars, tending to run from proximal, associated with broad patchy spread of polish along edge in scars. Polish is smooth invasive, allover, developed, bright, with soft edges and common small irregular pits.

Ventral side b: common scattered medium to small mostly feather terminating mostly shallow scars, tending to run from proximal, associated with a broad linear polish away from edge and on interior face. Polish is flat (rippled), allover, developed, bright, with abrupt edges and common medium irregular pits.

Interpretation: side b used, long motion

Comments: problems caused by burning effects

Ref: S1347
Type: SCRAPER
Blank: FLAKE
Mat: FLINT
Dim: 25x19x7
Qual: POOR
Cond: ABRADED



Material: Grain: F Homog: H Crys: O Topo: F Fissures: A

Edge Angle: thick

Traces:

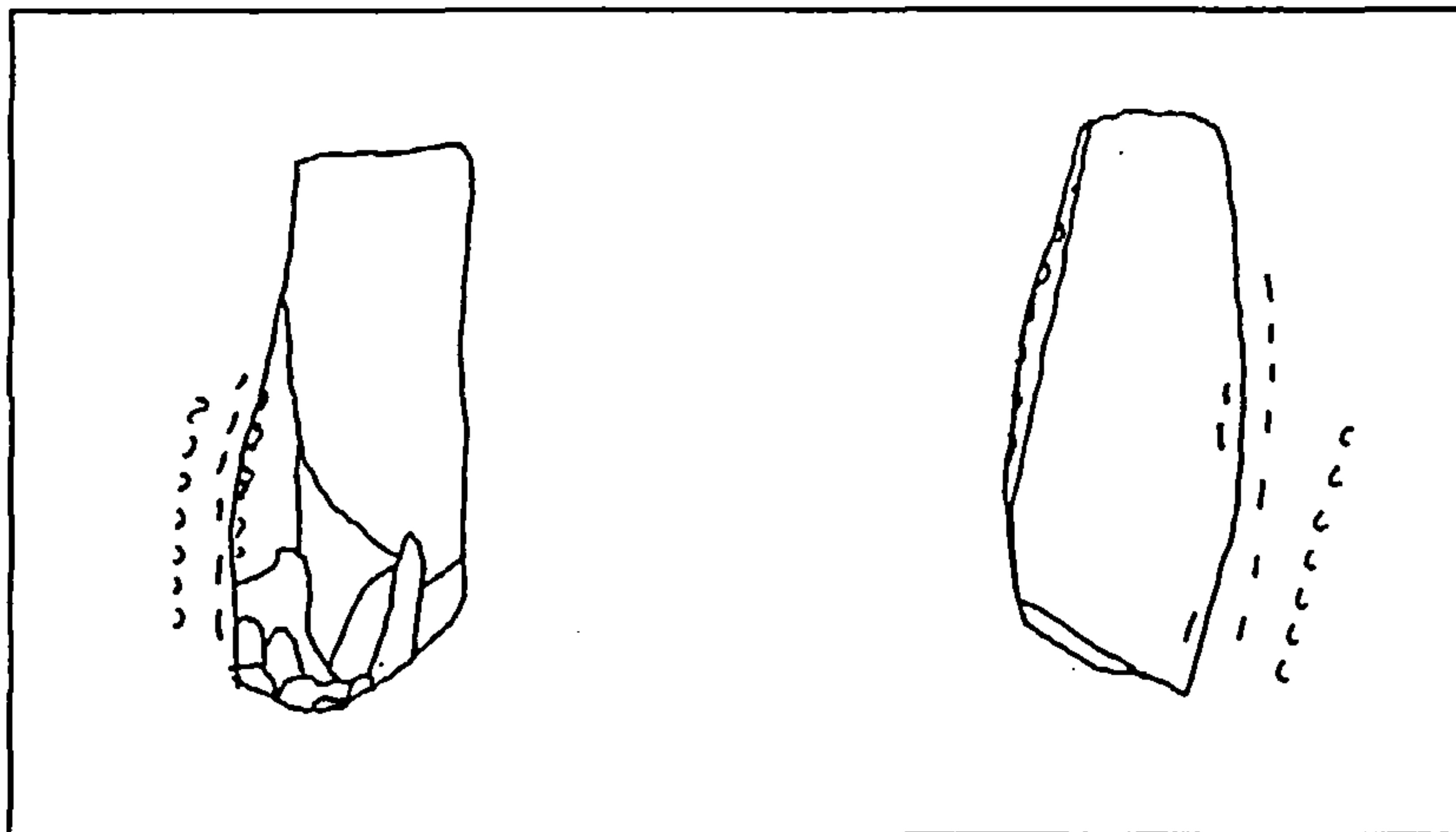
Edge damage not recorded because of retouch

Ventral proximal end: A: Patchy broad linear polish along edge. Polish is smooth domed. Polish B: restricted patches away from edge. Polish is smooth flat (rippled), allover, developed, bright, with abrupt edges and common medium irregular pits.

Dorsal proximal: Broad spread along and away from edge. Polish is smooth domed, partially linked, developed, with sharp edges and occasional medium irregular pits. Associated are perpendicular medium medium narrow and fine striations.

Interpretation: proximal end used, transverse motion
Comments: despite abrasion polish all clear. Use of proximal poor scraper end rather than well made fine distal scraper end.

Ref: S1349
Type:
Blank: BLADE
Mat: FLINT
Dim: 48x24x7
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: medium

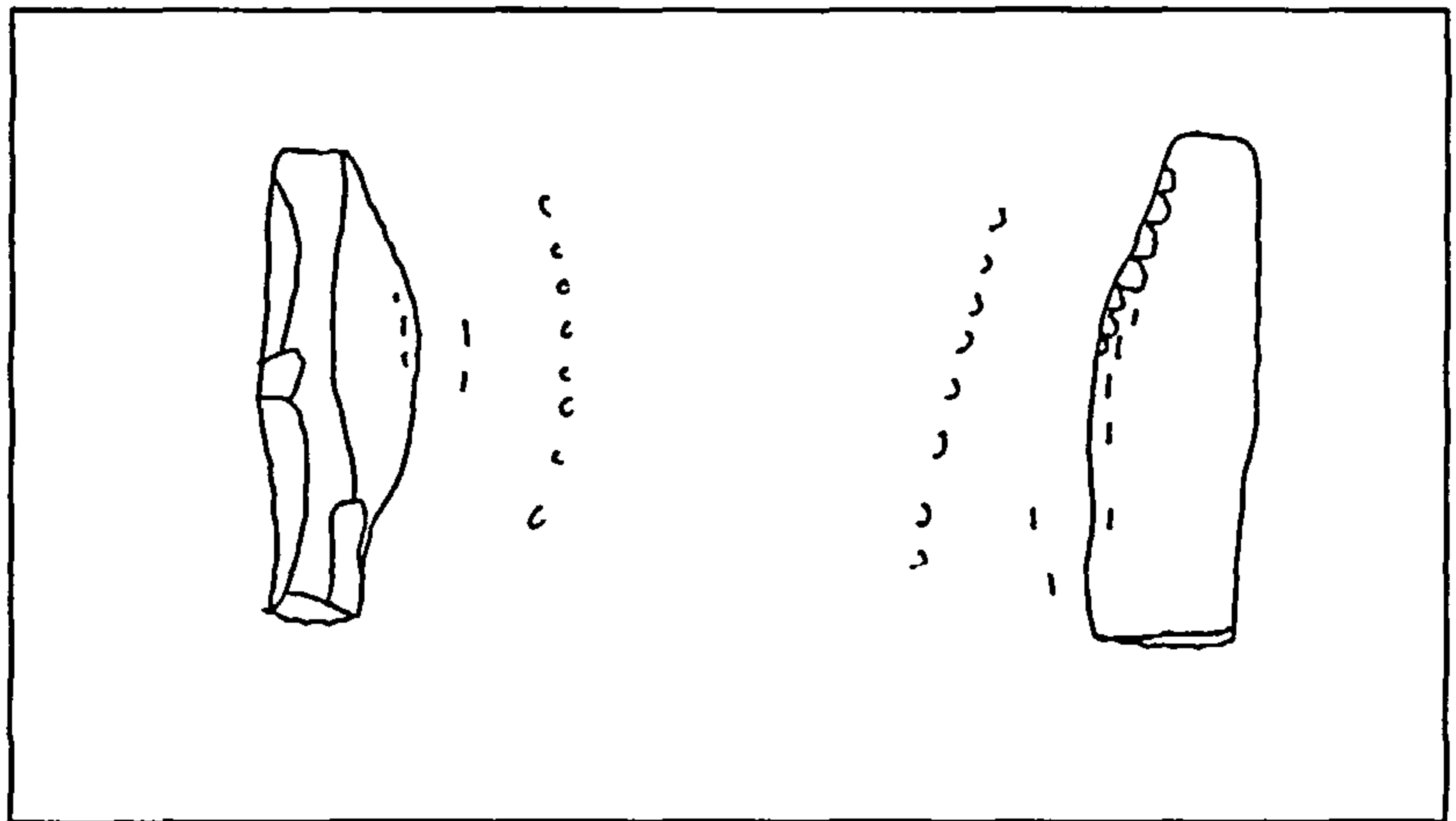
Traces:

Dorsal side a: frequent clustered small mostly step terminating deep scars associated with A: broad spread of polish along the edge. Polish is smooth domed (reticulated), partially linked, developed, variable with gradual edges and common variable irregular pits. Also D: restricted patches on edge. Polish is smooth flat, partially linked, developed, bright, with sharp edges and no internal features.

Ventral side a: common clustered large to medium mostly step terminating deep scars, associated with A, and with B: restricted linear polish at 75o on interior. Polish is smooth flat, partially linked, with abrupt edges and occasional medium irregular pits and common 75o fine internal lines. Associated with 75o medium deep fine striations. Also with C: patchy linear polish away from edge. Polish is smooth domed allover, developed, with sharp edges and no internal features.

Interpretation: side a used, long motion, hard material
Comments: no traces on retouch

Ref: S1350
Type: MISC RET
Blank: BLADE
Mat: FLINT
Dim: 33x13x4
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

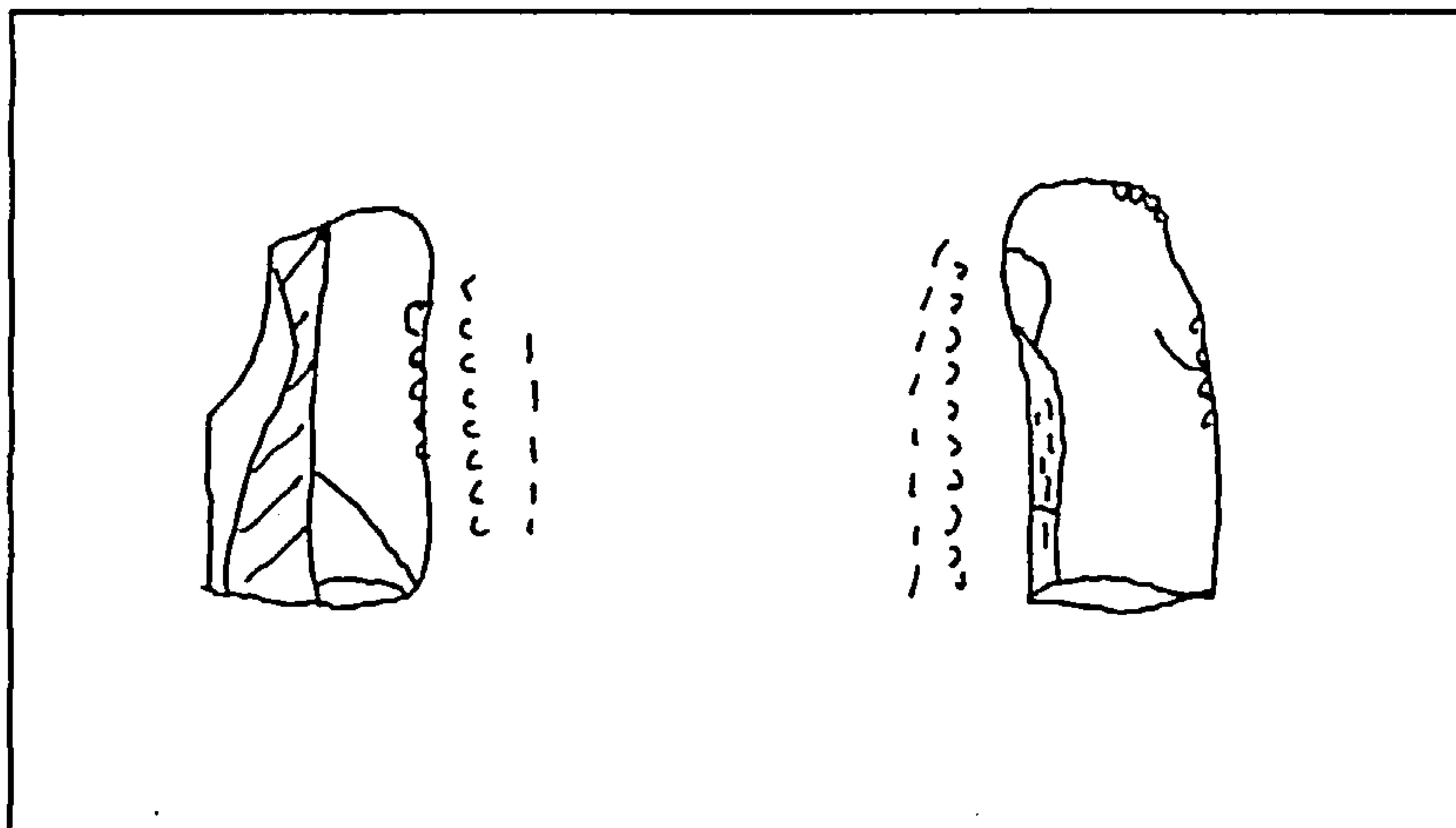
Edge Angle: medium

Traces:

Side b, both faces very similar: Frequent clustered and layered medium to small step terminating deep scars, with good bidirectionality, associated with A: restricted patches away from edge. Polish is smooth flat, partially linked, developed, bright, with abrupt edges and occasional small irregular pits. Also with B: patchy polish on edge. polish is smooth domed and invasive, partially linked, with gradual edges and common medium irregular pits. Also with C: patchy polish on and away from edge. Polish is smooth domed invasive (flat fluid infilling), developed, variable, with gradual edges and frequent small circular pits.

Interpretation: side b used, long motion, sawing, hard material
Comments:

Ref: S1353
Type: ED
Blank: FLAKE
Mat: FLINT
Dim: 23x14x9
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures: A

Edge Angle: thick

Traces:

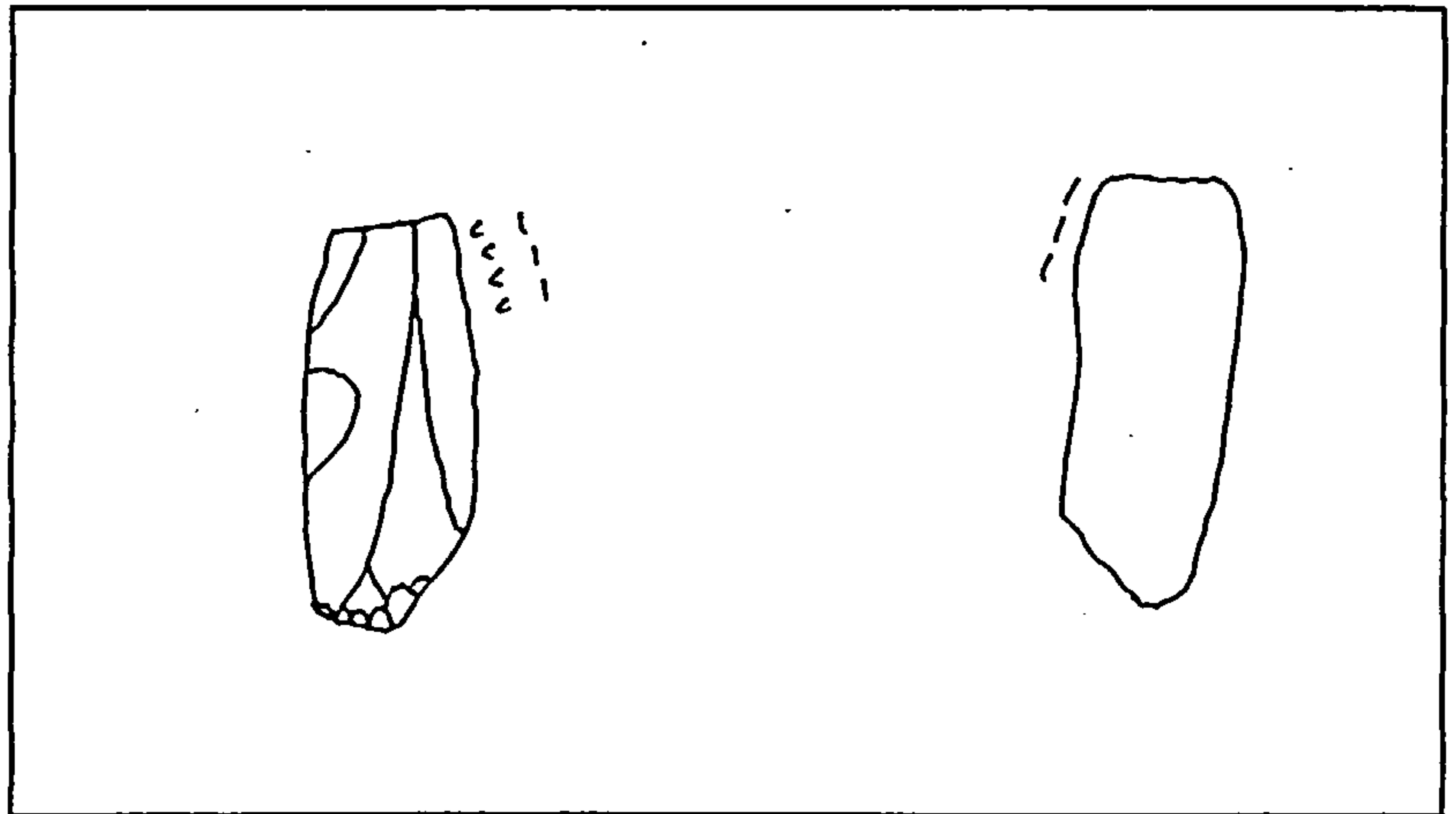
Dorsal side b: numerous clustered and layered medium to small step terminating deep scars associated with B: broad spread of polish along and away from edge. Polish is rough invasive (reticulated), partially linked, developed, with gradual edges and no internal features.

Ventral side b: numerous clustered and layered step terminating deep scars associated with B, and with A: patchy polish on interior. Polish is rough flat, allover, developed, with sharp edges and common large irregular pits. Associated with parallel long deep narrow frequent striations. Also with C: broad spread away from edge. Polish is rough reticulated, partially linked, with gradual edges and occasional 45o linearity. Associated with random medium deep medium occasional striations.

Interpretation: side b used, long motion

Comments: good bidirectional evidence from scars

Ref: S1356
Type:
Blank:
Mat: FLINT
Dim:
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A

Edge Angle: thick

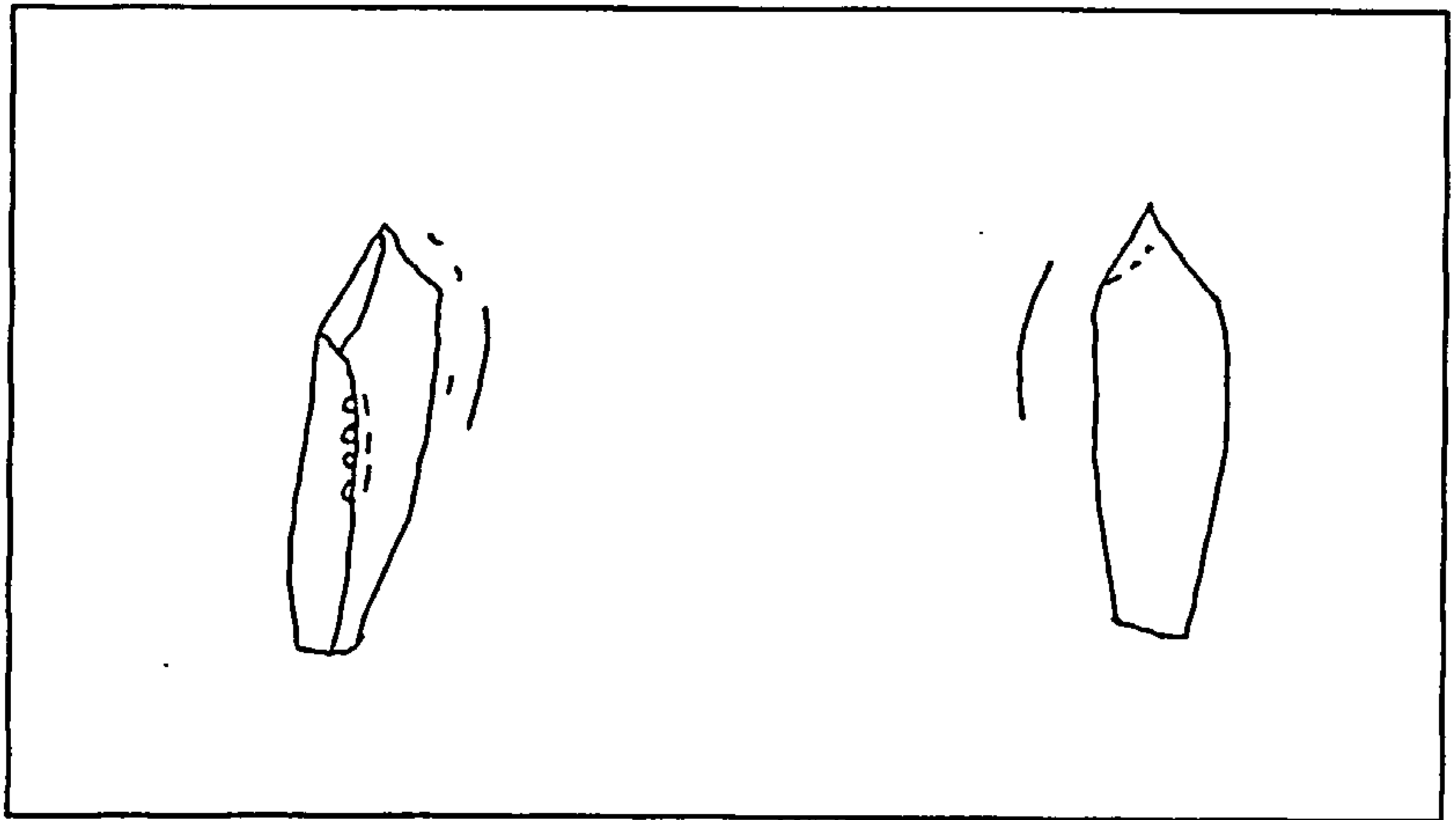
Traces:

Dorsal side b: common clustered and layered medium to small mostly feather terminating deep scars associated with restricted patchy polish away from the edge. Polish is smooth reticulated, scattered, with sharp edges and no internal features.

Ventral side b: no edge damage. Patchy polish along edge. Polish is rough reticulated, partially linked, poor with gradual edges and no internal features

Interpretation: side b used, opp/marginal use
Comments:

Ref: S1360
Type:
Blank: BLADE
Mat: CHERT
Dim: 17x5x3
Qual: MED
Cond: FRESH



Material: Grain: M Homog: H Crys: O Topo: F Fissures:
O

Edge Angle: medium

Traces:

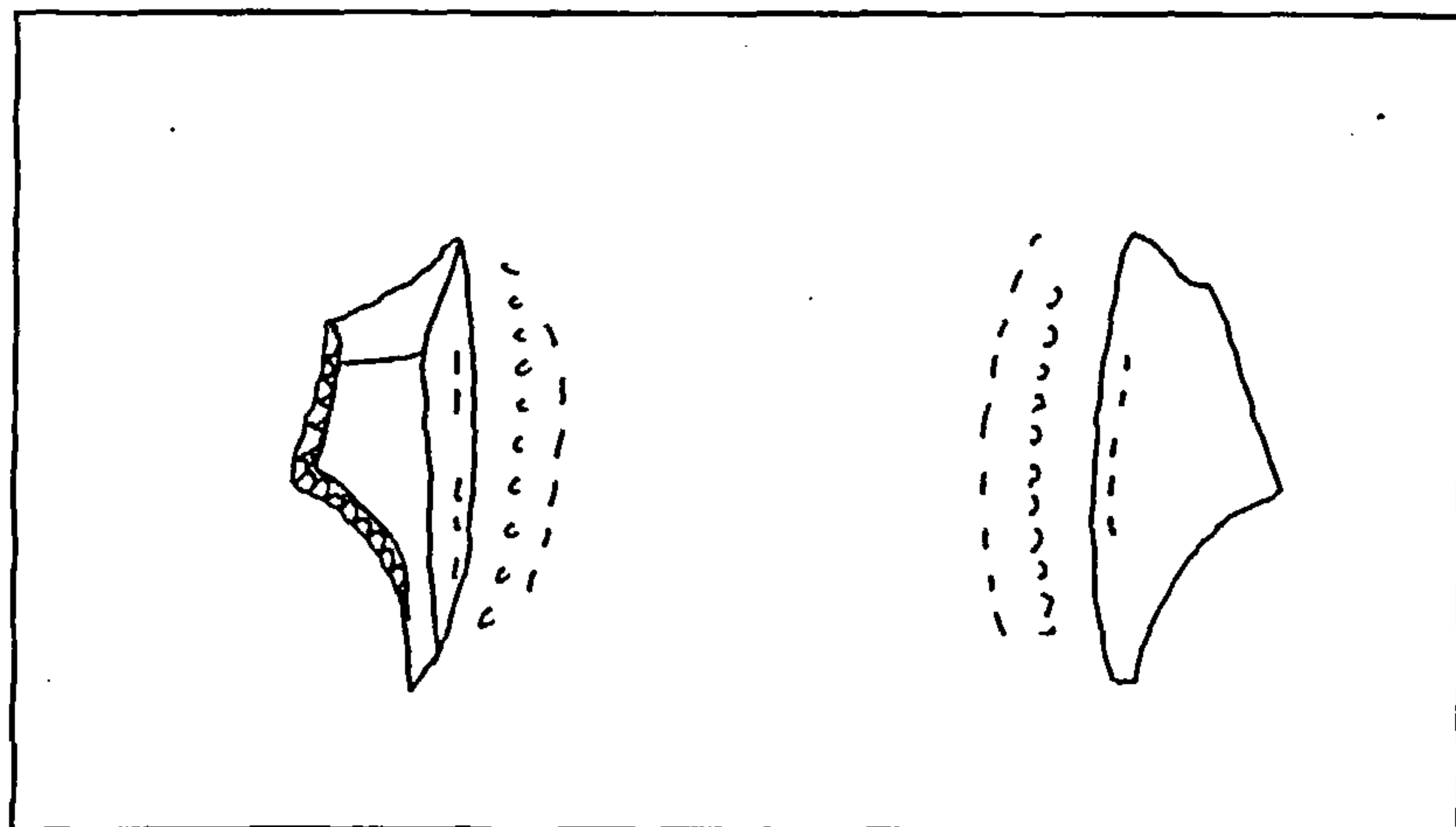
Side b, both faces similar: Edge rounded with occasional scars, associated with polish along edge. Polish is smooth domed (reticulated), developed, with sharp edges and occasional small irregular pits. Also with linear patches along edge. Polish is smooth domed, partially linked, with gradual edges and no internal features.

· Dorsal ridge scarred and with polish patches

Interpretation: side b used, transverse use suggested by traces on ridge.

Comments:

Ref: S1361
Type: MICRO
Blank: BLADE
Mat: FLINT
Dim: 23x12x2
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures: A

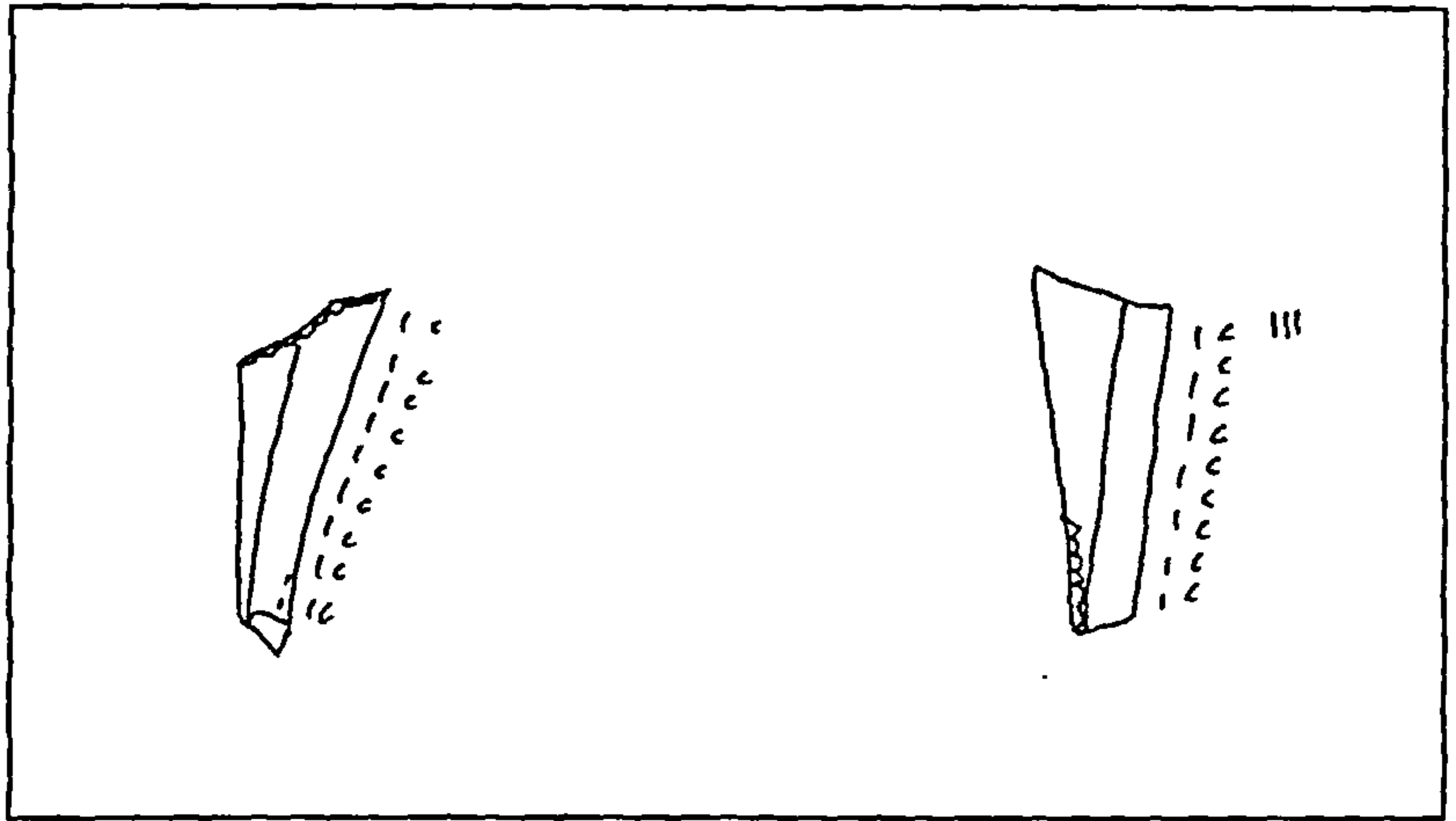
Edge Angle: acute

Traces:

Side b, both faces very similar: frequent to numerous clustered medium to minute mostly feather terminating deep scars with some snaps, good bidirectionality, associated with A: patchy polish along and away from edge. Polish is smooth flat, allover, intense, bright, with abrupt edges and frequent variable irregular pits. Forms bevel. Associated with parallel medium deep fine frequent striations. Also with B: restricted patches away from edge. Polish is smooth domed, allover, intense, bright with abrupt edges and common minute irregular pits. Also with C: broad patchy spread away from edge. Polish is smooth flat reticulated, partially linked, developed, with sharp edges and occasional small circular pits. Also with D: restricted patches away from edge. Polish is smooth flat reticulated, scattered, developed, with abrupt edges and common minute irregular pits. Also with E: broad spread along and away from edge. Polish is smooth invasive, partially linked, with gradual edges and no internal features.

Interpretation: side b used. Long motion, bidirectional
Comments:

Ref: S1366
Type: MICRO
Blank: BLADE
Mat: CHERT
Dim: 13x5x4
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A

Edge Angle: thick

Traces:

Dorsal side b and ventral side a: common clustered medium step terminating deep scars.

Polish A: broad spread on and away from edge. polish is smooth reticulated, partially linked, developed, with gradual edges and occasional small irregular pits.

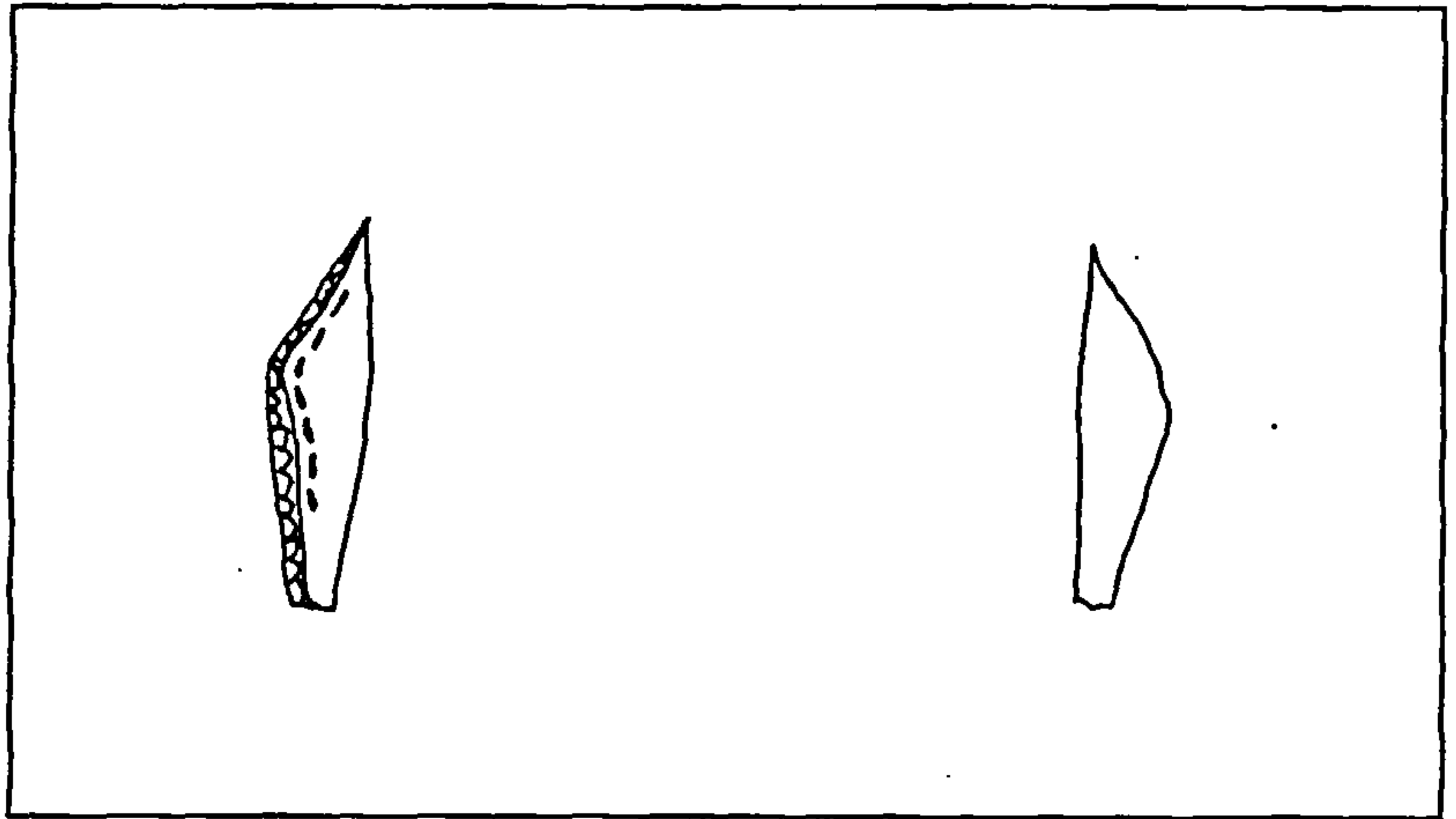
Polish B: restricted patchy polish on edge. Polish is smooth domed, allover, intense, bright, with sharp edges and occasional small irregular pits. Associated with parallel short deep narrow and fine striations.

Polish C: restricted patchy polish away from edge. Polish is smooth domed, partially linked, with gradual edges and occasional small irregular pits. Associated with parallel long deep medium striations.

Interpretation: used, complex

Comments: very difficult, massive polishing, but definitely not projectile.

Ref: S1367
Type: MICRO
Blank: BLADE
Mat: FLINT
Dim: 15x5x3
Qual: MED
Cond: FRESH



Material: Grain: M Homog: H Crys: O Topo: R Fissures:
O

Edge Angle: thick

Traces:

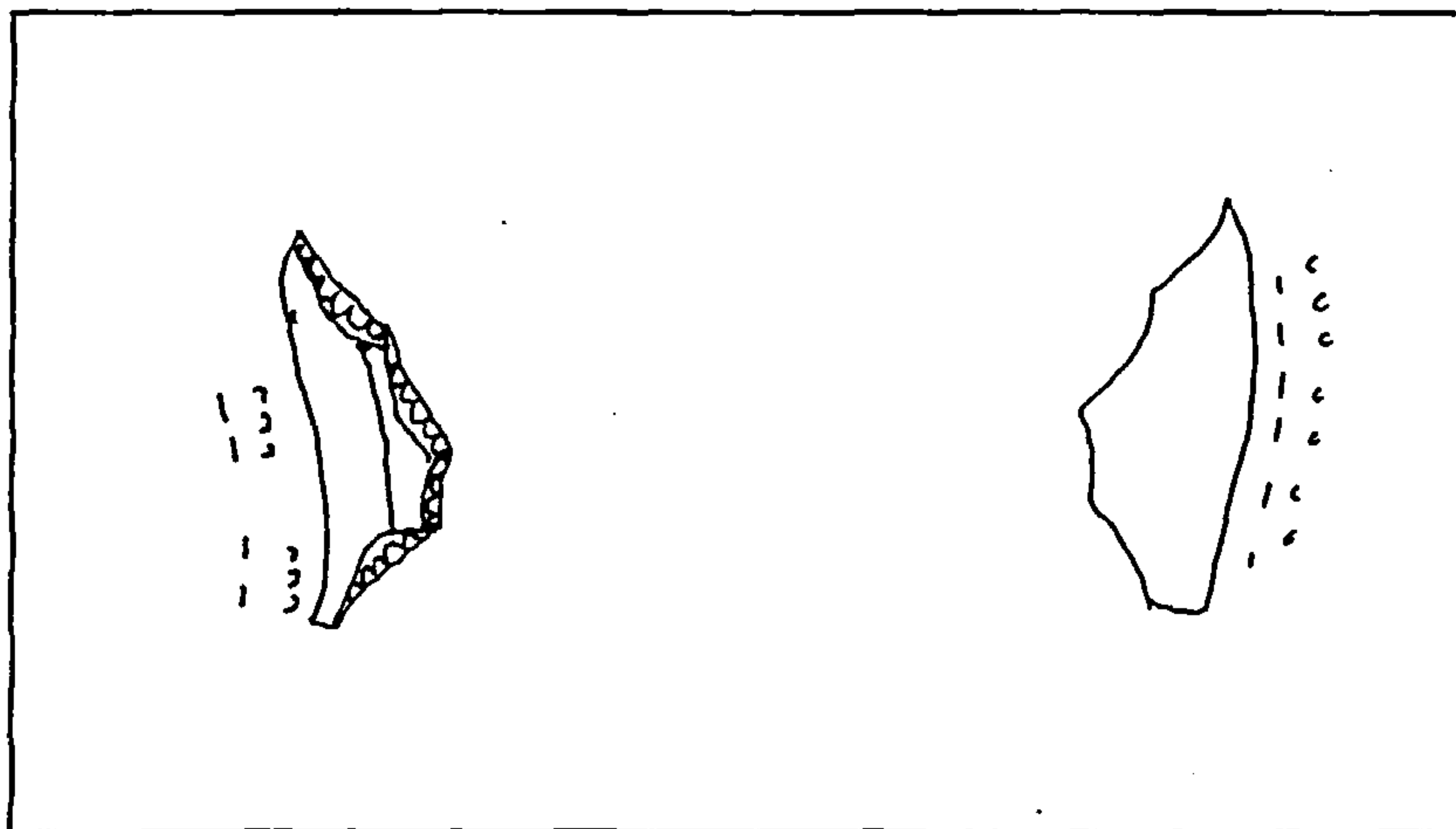
Edge damage not recorded because of retouch

Dorsal ridge: narrow linear polish running along ridge. Polish is smooth domed, allover, intense, bright, with sharp edges and rare minute circular pits. Associated with perpendicular short deep narrow striations.

Interpretation: used, transverse

Comments: does not resemble techno traces. Use of dorsal ridge to scrape?

Ref: S1368
Type: MICRO
Blank: BLADE
Mat: FLINT
Dim: 21x8x2
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: acute

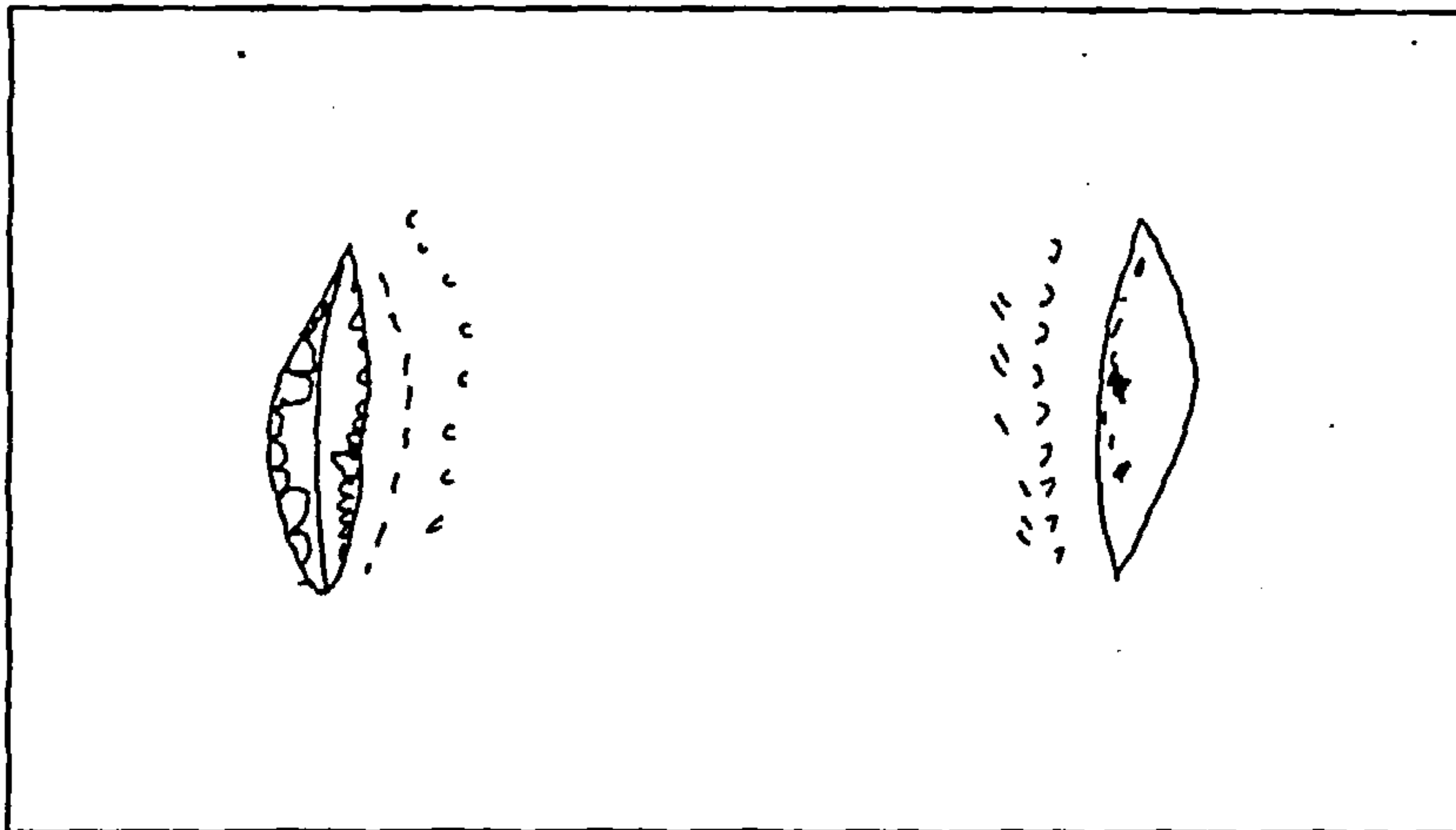
Traces:

Dorsal side a: occasional clustered small mostly feather terminating mostly shallow scars, associated with restricted patches of polish on the edge. Polish is smooth flat, partially linked, developed, with abrupt edges and occasional medium irregular pits. Also with restricted narrow linear polish along edge. Polish is smooth invasive, partially linked, poor, with gradual edges and no internal features.

Ventral side a: common clustered medium to small mostly feather terminating mostly shallow scars, associated with restricted patches of polish on the edge. Polish is smooth domed, scattered, with sharp edges and no internal features.

Interpretation: side a used, long motion, light use
Comments:

Ref: S1371
Type: MICRO
Blank: BLADE
Mat: FLINT
Dim: 15x5x3
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A

Edge Angle: medium

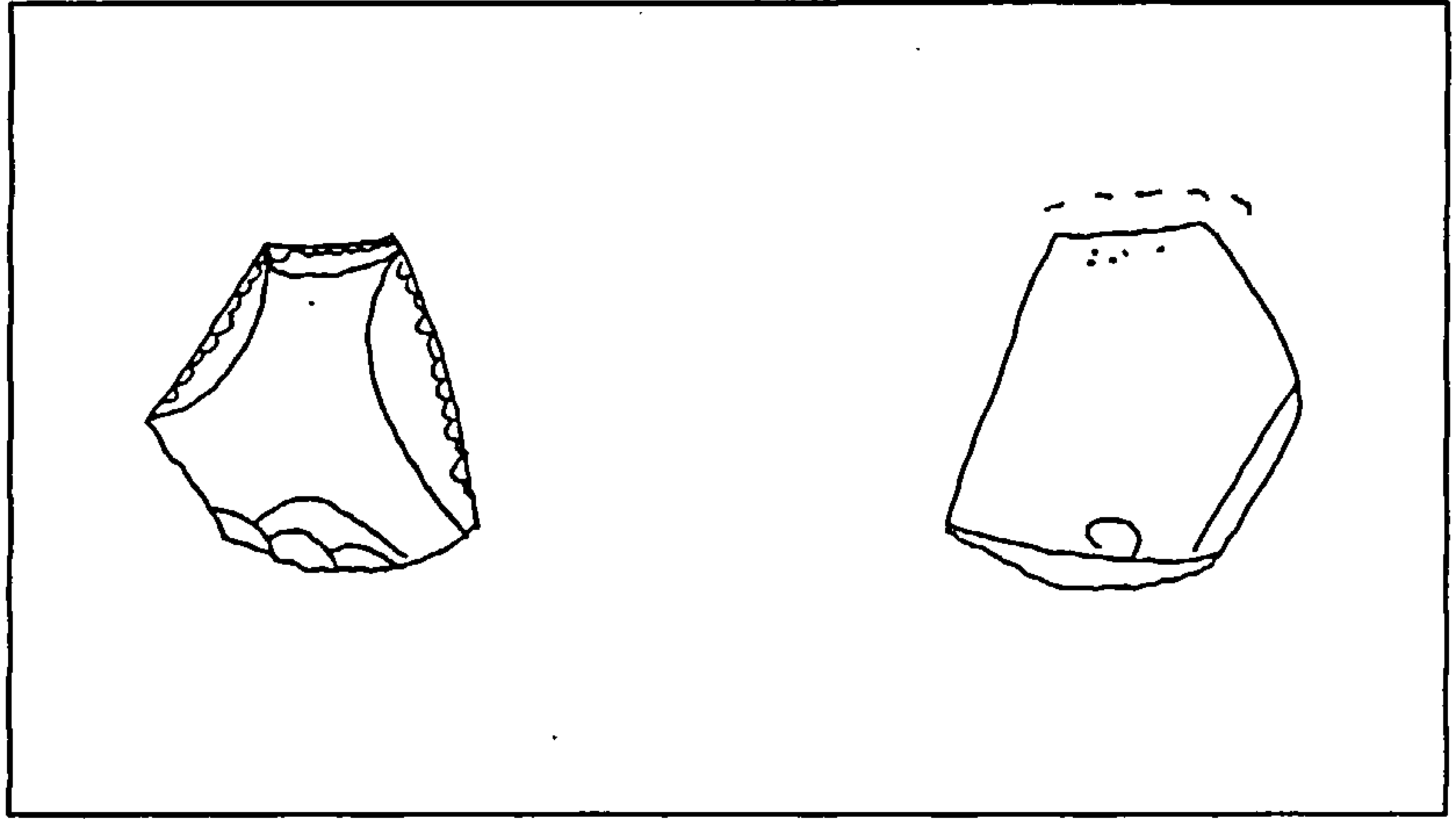
Traces:

Dorsal side b: edge damage not recorded because of retouch. Polish A: patchy along edge. Polish is smooth flat, partially linked, developed, with abrupt edges and occasional mixed irregular pits. Associated with perpendicular medium deep fine rare striations. Polish B: restricted patches along edge. Polish is smooth domed, partially linked, developed, with gradual edges into A. Polish C: broad spread along edge. Polish is smooth reticulated, scattered, developed, with soft edges and no internal features.

Ventral side b: common clustered small to minute mostly feather terminating deep scars, single flaking direction, associated with polish A and polish D: restricted patches on interior. Polish is smooth flat, all over, intense, with abrupt edges and common medium irregular pits. Also polish E: patchy spread along edge. Polish is smooth domed, scattered, developed, with gradual edges and no internal features. Forms edge bevel. Associated with 750 short shallow fine striations. Polish F: restricted patches away from edge. Polish is smooth domed, all over, intense, with abrupt edges and occasional small irregular pits

Interpretation: side b used, long motion, one direction
Comments:

Ref: S1375
Type: scraper
Blank: flake
Mat: CHERT
Dim: 22x18x6
Qual: GOOD
Cond: FRESH



Material: Grain: M Homog: H Crys: O Topo: F Fissures:
O

Edge Angle: thick

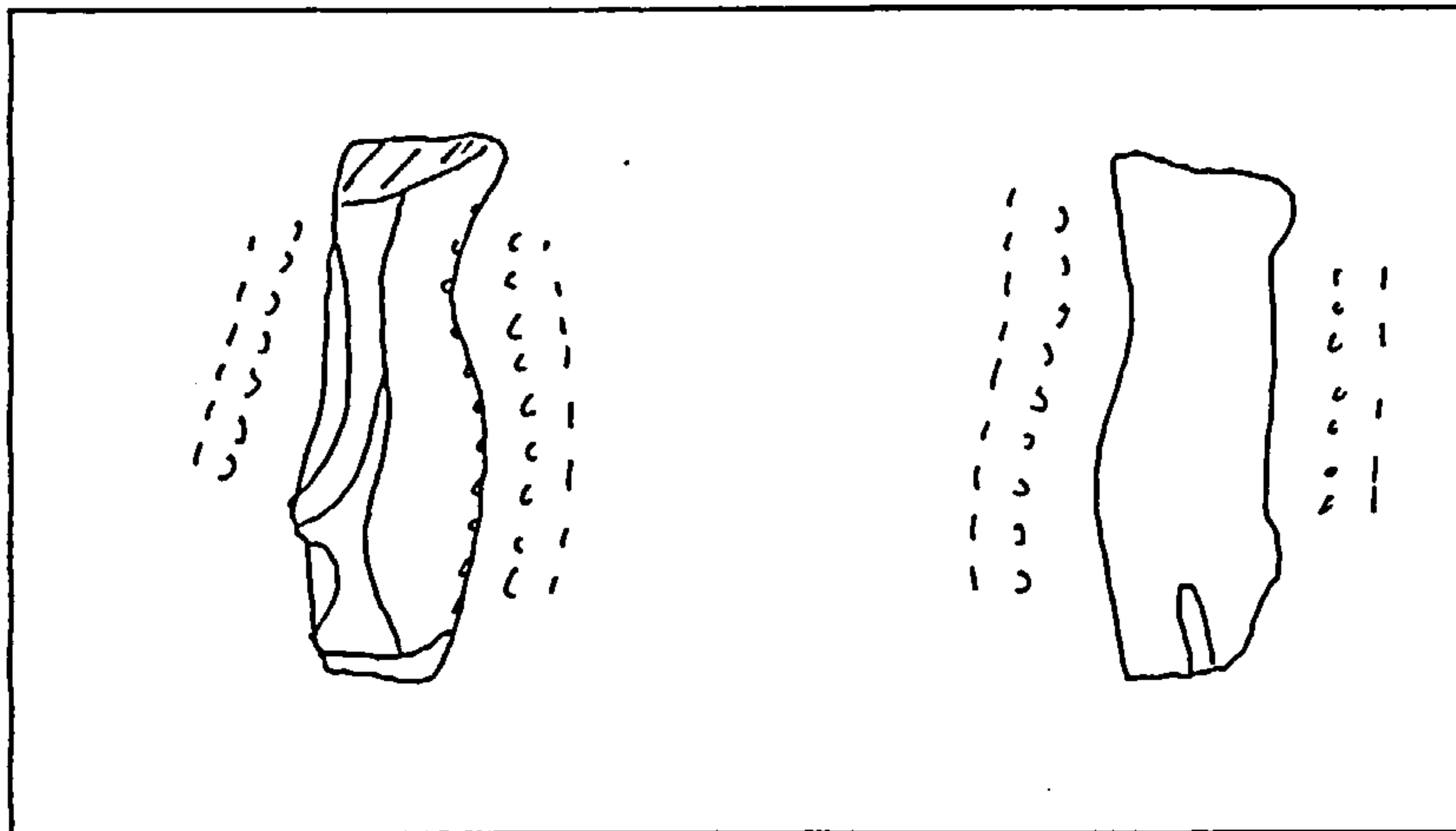
Traces:

No traces on dorsal, impossible due to retouch and
techno gloss

Ventral distal end: no edge damage. Patchy spread of
polish along and away from edge. Polish is smooth
flat, scattered, developed, with sharp edges and
occasional minute irregular pits.

Interpretation: Distal end used, transverse motion
Comments: clear, despite numerous techno features from
retouching process

Ref: S1379
Type: ED
Blank: BLADE
Mat: FLINT
Dim: 34x14x5
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures: A

Edge Angle: side a: thick, side b: acute

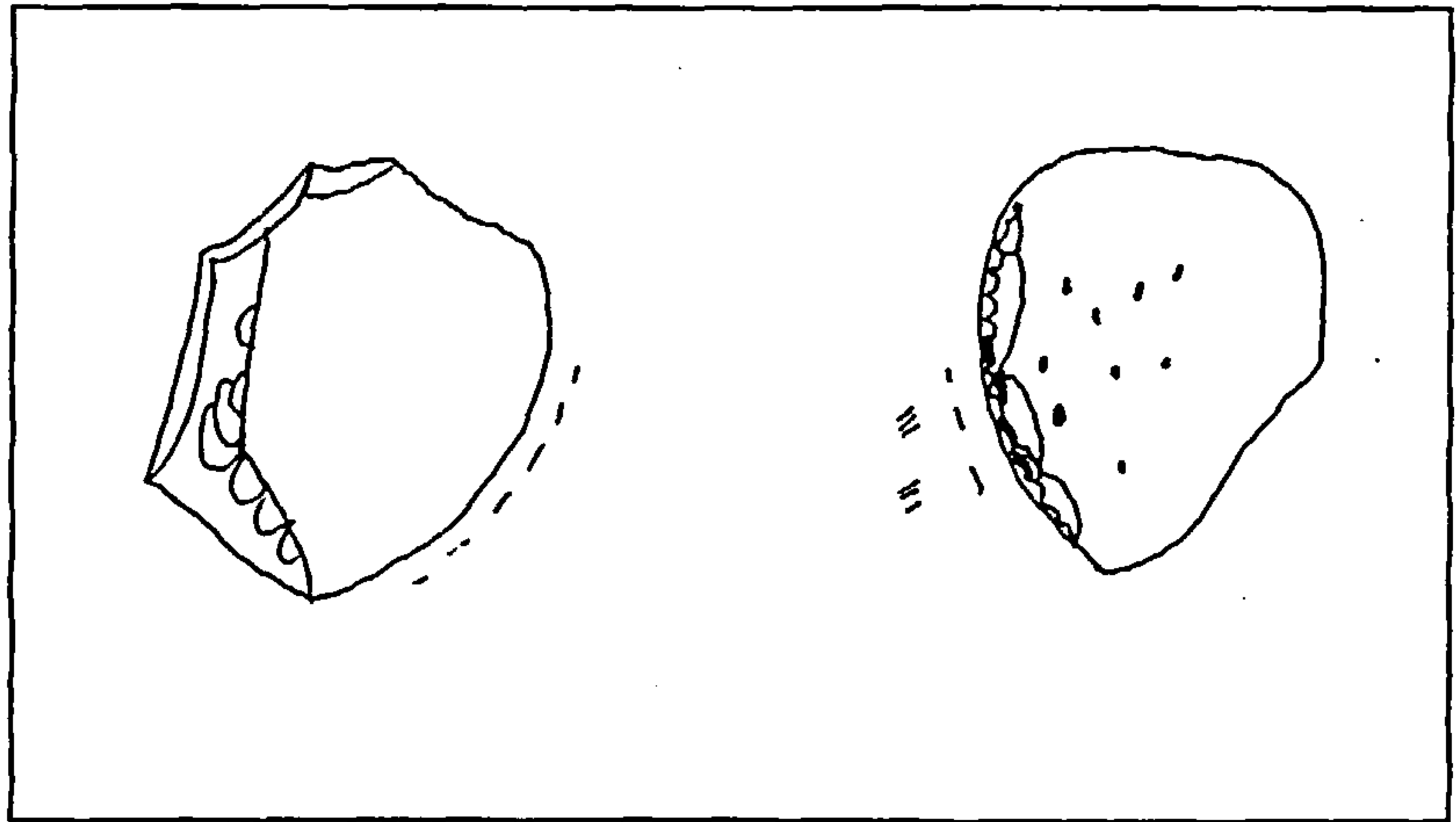
Traces:

Both sides, both faces very similar: occasional (on dorsal side a numerous) clustered and layered large to medium step terminating deep scars associated with patchy polish on and away from edge. Polish is smooth domed, scattered, developed, bright, fairly sharp edges with occasional small irregular pits.

Interpretation: Both sides used, long motion, prob hard material.

Comments: the same use on both sides.

Ref: S1381
Type: SCRAPER
Blank: FLAKE
Mat: CHERT
Dim: 28x26x10
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
O

Edge Angle: thick

Traces:

edge damage not recorded because of retouch

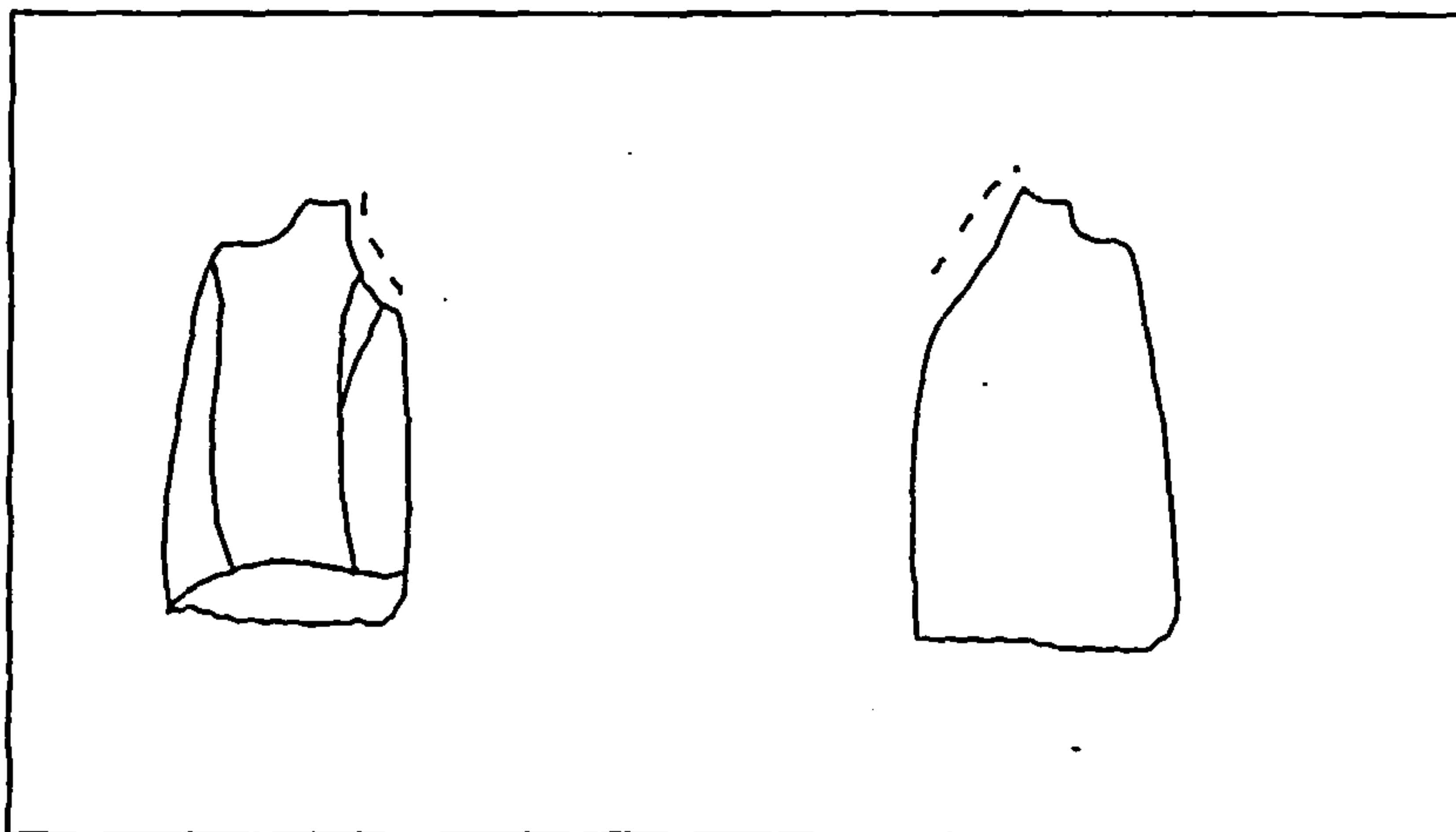
Dorsal side b: Polish B: patchy linear polish along edge. Polish is smooth domed (invasive) all over, developed, variable, with gradual edges and occasional small circular pits.

Ventral side b: polish B. Polish C: patchy polish away from edge. Polish is smooth domed, all over, developed, with gradual edges and occasional small circular pits. Associated are perpendicular long deep narrow frequent striations.

Ventral face: Polish A: Patchy polish on interior. Polish is smooth flat all over, developed, bright, variable, with sharp edges and occasional small irregular pits.

Interpretation: Side b used, transverse
Comments: as scraper

Ref: S1399
Type:
Blank:
Mat: CHERT
Dim: 28x22x9
Qual: POOR
Cond: FRESH



Material: Grain: M Homog: H Crys: F Topo: F Fissures:
O

Edge Angle: medium

Traces:

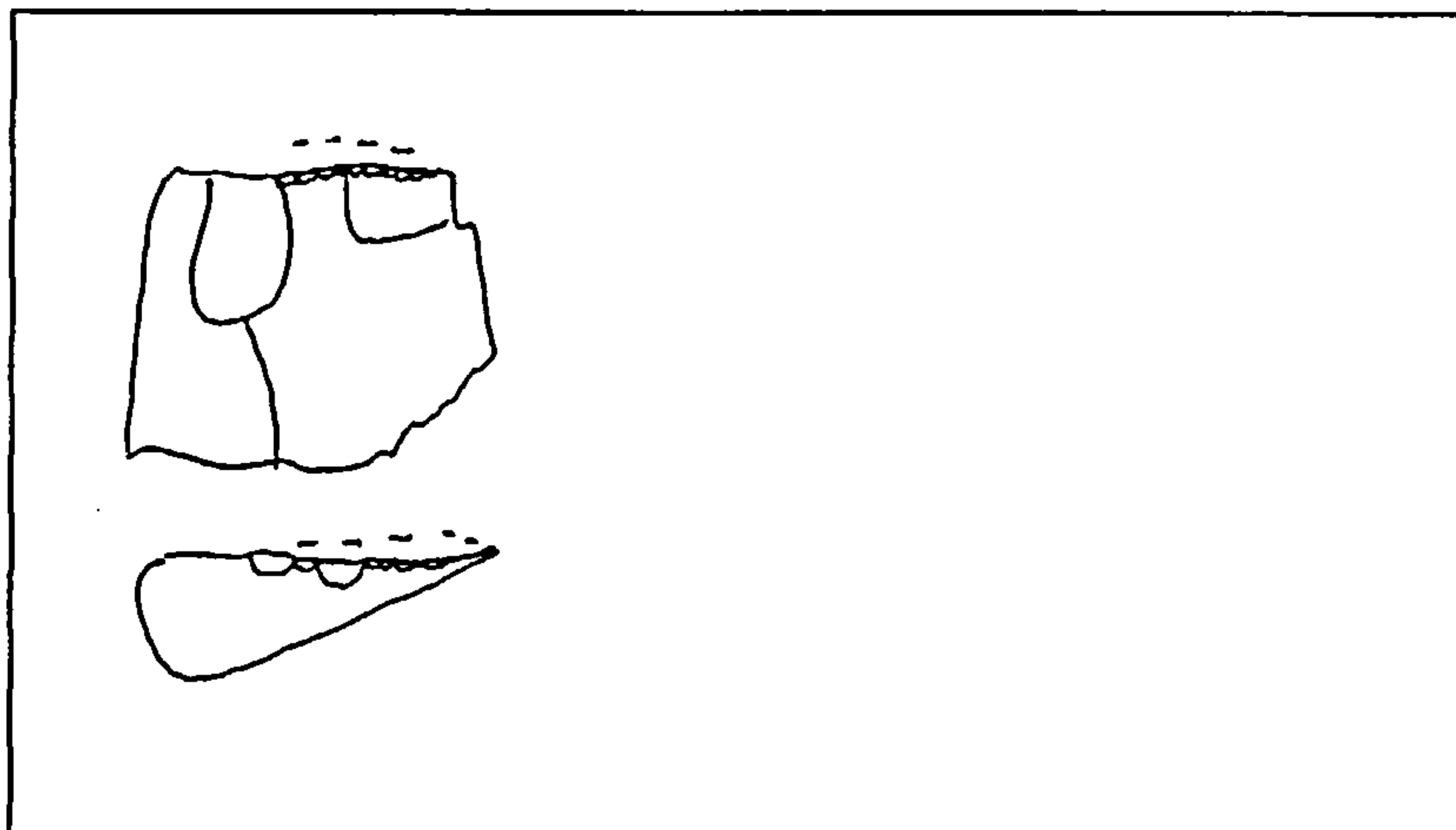
Dorsal distal: no edge damage. Broad spread of polish along and away from edge. Polish is smooth flat, partially linked, developed, with gradual edges and occasional small irregular pits.

Associated are 450 short shallow broad striations. Also patchy polish away from edge. Polish is smooth invasive, all over, developed, with gradual edges and occasional small irregular pits.

Ventral distal: no edge damage. Restricted patchy polish away from edge. Polish is smooth invasive, partially linked, with gradual edges and occasional small irregular pits.

Interpretation: Distal used, longitudinal, soft material, grooving
Comments:

Ref: S1505
Type: CORE
Blank: CORE
Mat: FLINT
Dim: 20x32x27
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A

Edge Angle: thick

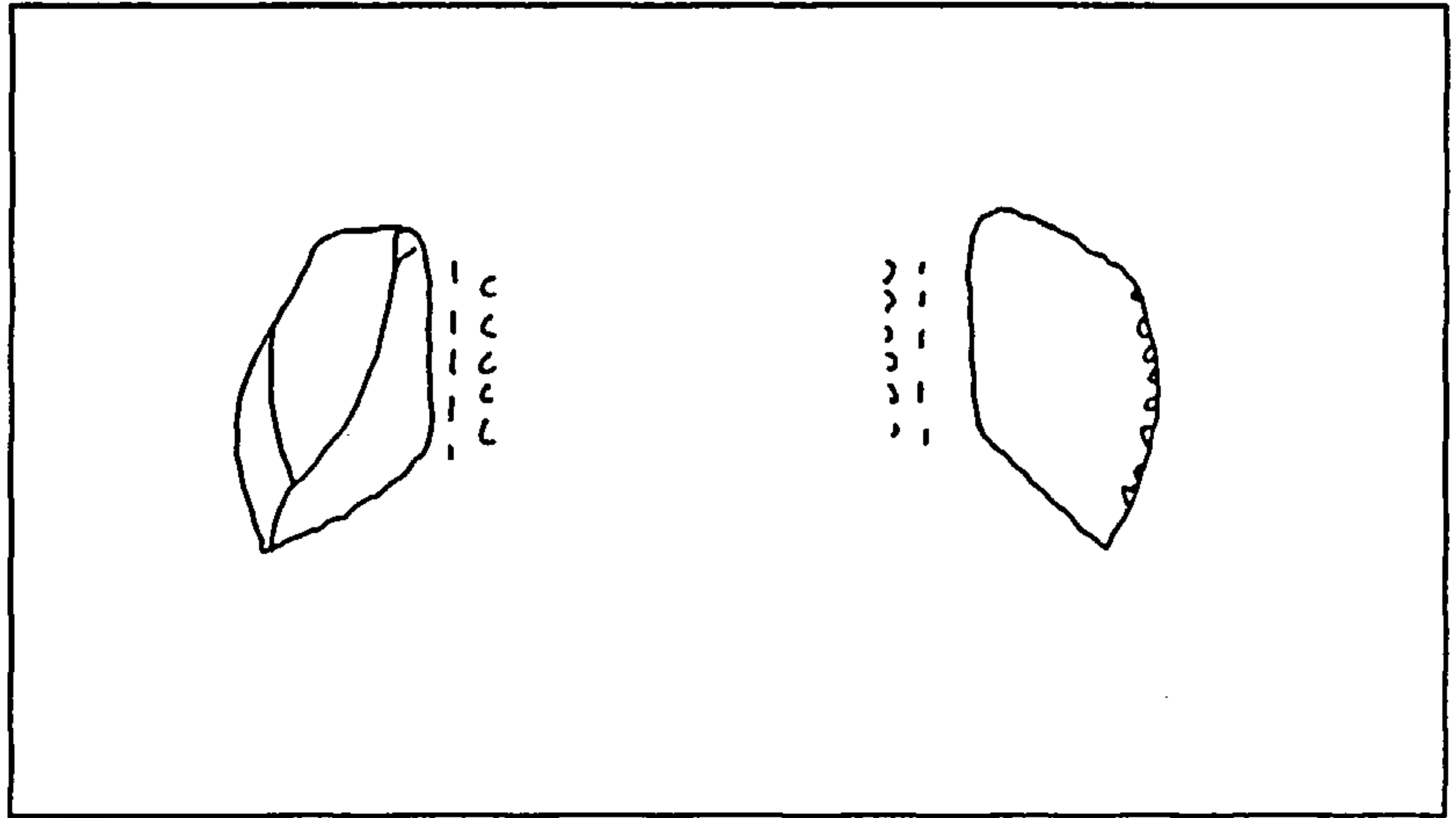
Traces:

Techno features and battering make recording
difficult, especially edge damage

Polish: restricted patchy polish on edge. Polish is
smooth invasive, partially linked, developed,
variable, with sharp edges and occasional medium
circular pits. Associated perpendicular medium,
deep, fine striations

Interpretation: proximal used, transverse motion
Comments: as scraper

Ref: S1737
Type: ED
Blank: FLAKE
Mat: FLINT
Dim: 15x10x3
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

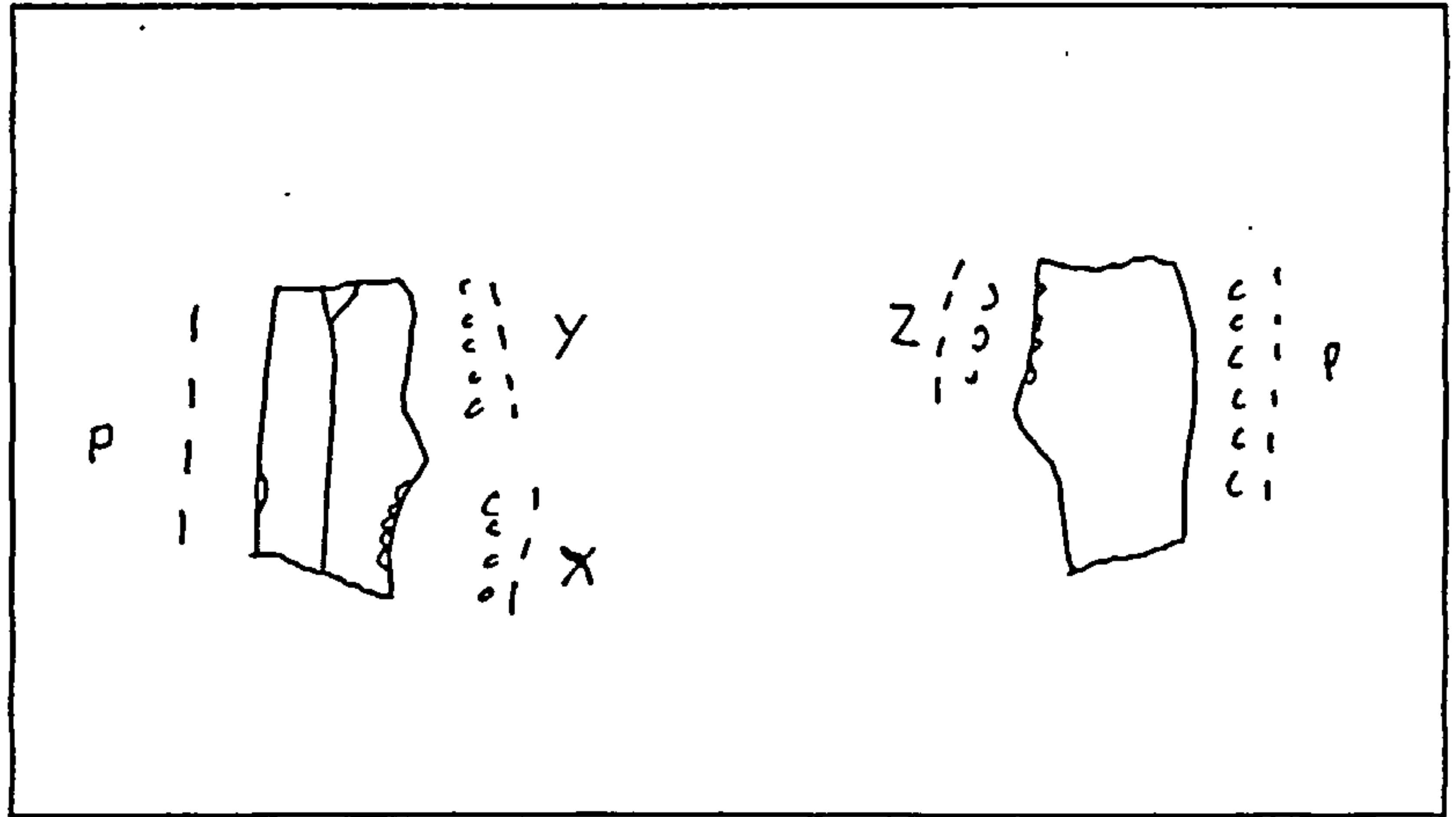
Edge Angle: medium

Traces:

Side b, both faces: Frequent clustered small mostly
step terminating deep scars, associated with
restricted narrow linear polish along the edge.
Polish is smooth invasive (liquid flat infilling),
scattered, variable with gradual edges and common
circular pits.

Interpretation: side b used, long motion, light use
Comments: numerous other effects, NUW

Ref: S1738
Type: ED
Blank: FLAKE
Mat: CHERT
Dim: 18x12x3
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures: A

Edge Angle: a = acute, b = medium

Traces:

At X: frequent clustered minute mostly feather terminating deep scars associated with polish A: restricted narrow linear along edge. Polish is smooth domed, scattered, with gradual edges and no internal features. Also C: restricted patches along edge. Polish is smooth domed, partially linked, developed, with gradual edges and occasional medium irregular pits.

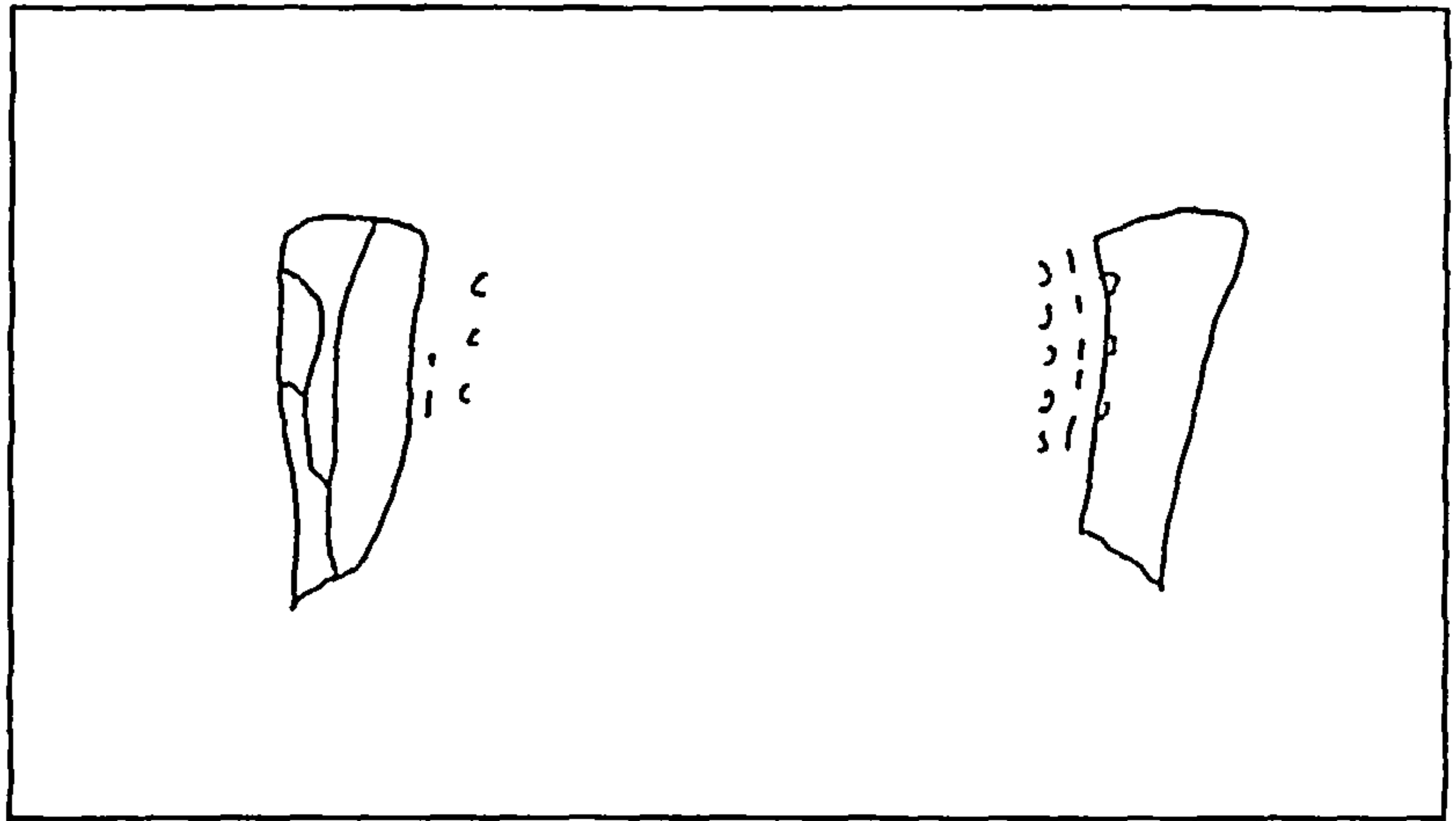
At Y: Occasional clustered large step terminating deep scars associated with B: broad patchy spread of polish along edge. Polish is smooth reticulated partially linked, variable with sharp edges and no internal features.

At Z: Common clustered large mostly feather terminating deep scars associated with B and D: broad spread on and away from edge. Polish is smooth domed invasive, (some flat fluid infilling), partially linked, developed, with gradual edges and common medium circular pits.

At P: Numerous clustered large mostly step terminating deep scars associated with E: restricted patchy polish. Polish is smooth flat, partially linked, developed, with no internal features. Associated with perpendicular medium, narrow striations. Also polish F: broad spread along edge. Polish is smooth invasive (reticulated), partially linked, with soft edges and no internal features.

Interpretation: Used, bilateral
Comments: complex

Ref: S1739
Type: ED
Blank: BLADE
Mat: CHERT
Dim: 17x7x2
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: medium

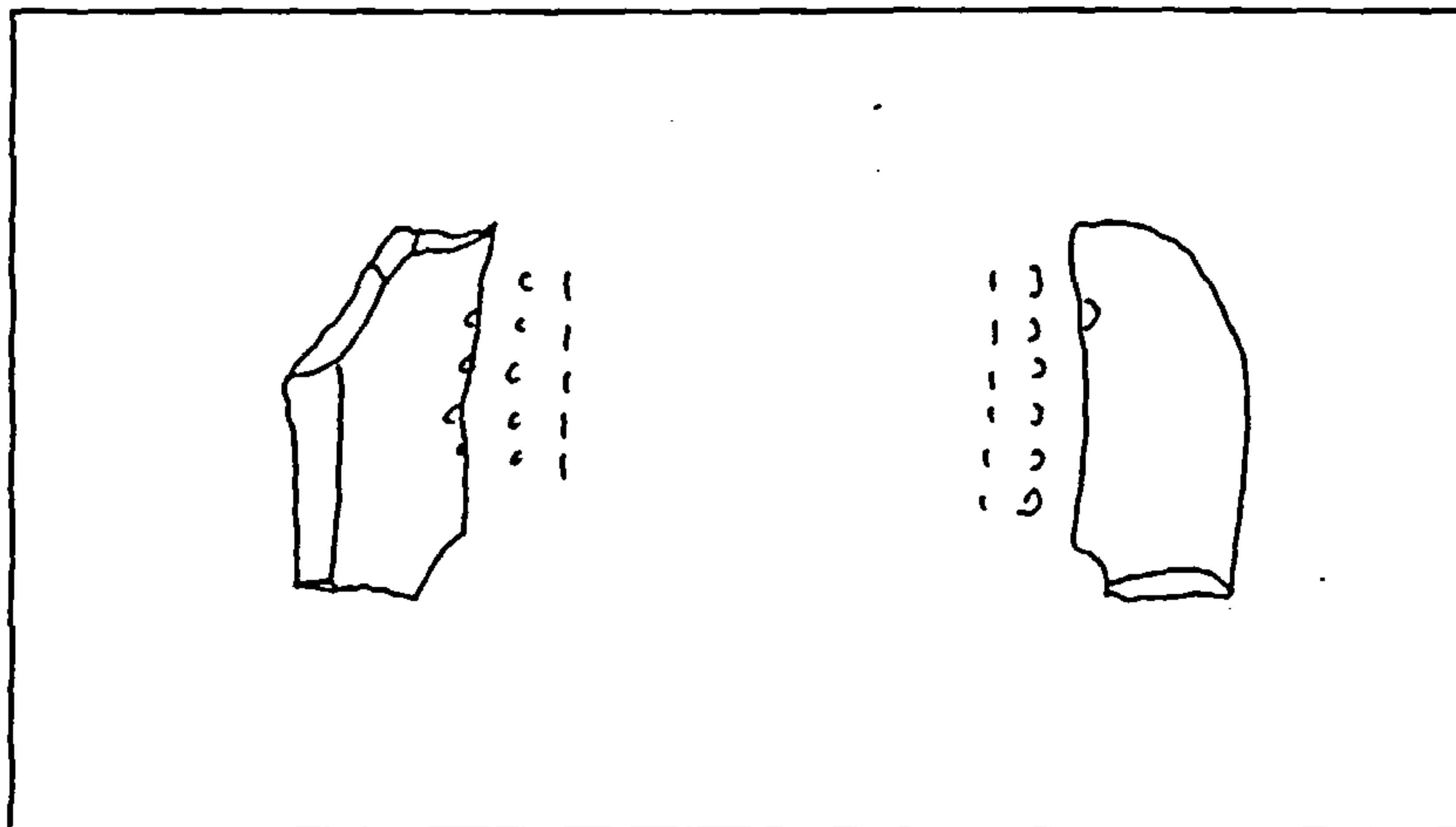
Traces:

Dorsal side b: minor edge damage. restricted patchy polish along edge. polish is smooth invasive, partially linked, with soft edges and occasional medium irregular pits.

Ventral side b: common clustered medium and minute mostly feather terminating deep scars, associated with restricted patchy polish on edge. Polish is smooth domed, allover, with sharp edges and occasional minute irregular pits. Restricted to protruding points between edge damage removals

Interpretation: side b used, transverse motion
Comments:

Ref: S1747
Type: ED
Blank: FLAKE
Mat: CHERT
Dim: 19x12x4
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: C Topo: F Fissures:
A

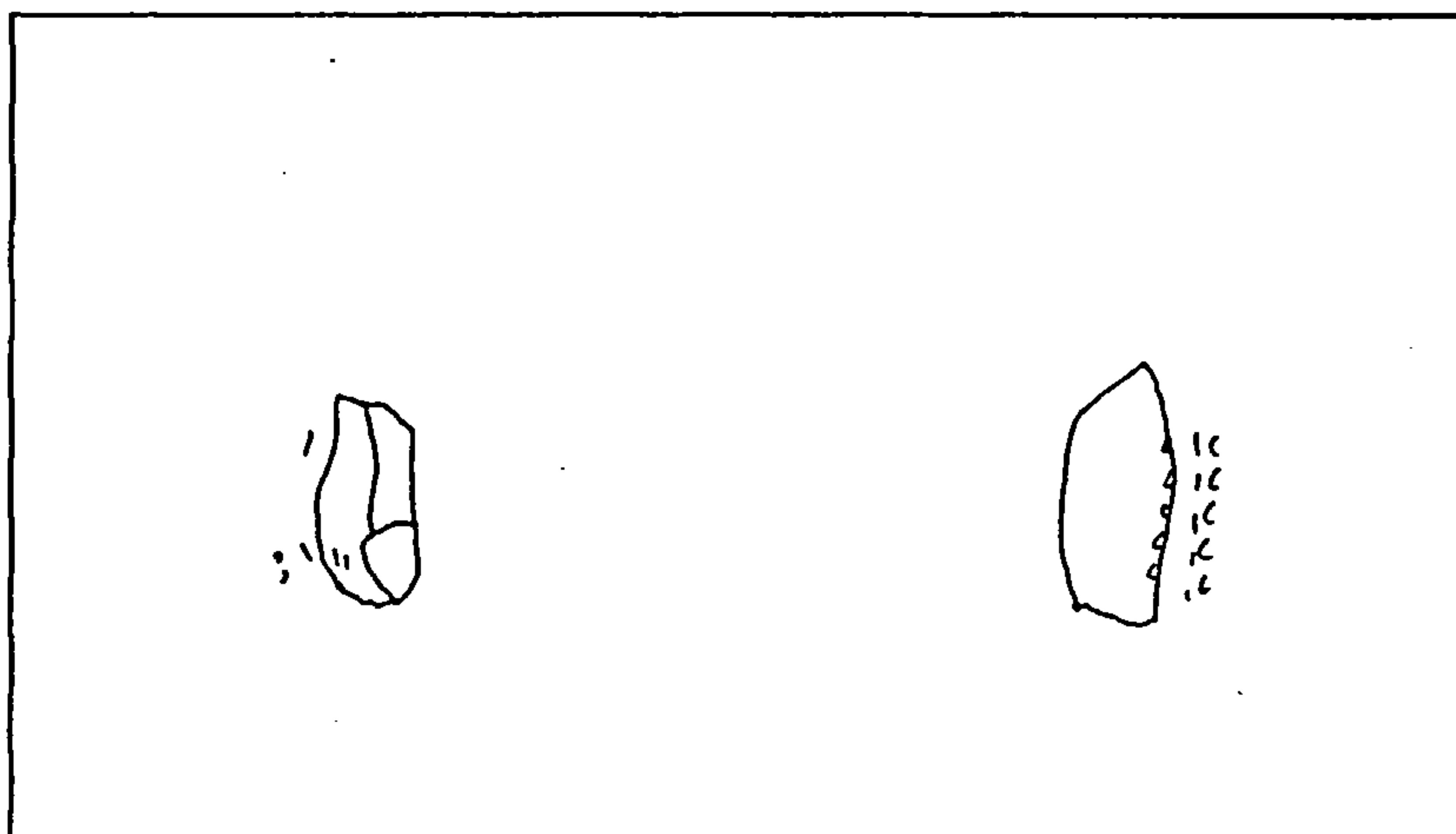
Edge Angle: medium

Traces:

Side b, almost identical on both faces: common to frequent clustered medium mostly feather terminating mostly deep scars, bidirectional, associated with broad spread along edge. Polish is smooth invasive or reticulated, partially linked, poor, variable, with gradual edges and no internal features. Infills scars. Also with restricted narrow linear polish along edge. Polish smooth domed, partially linked, developed, with gradual edges and no internal features.

Interpretation: side b used, long motion, bidirectional
Comments: baked by thick edge

Ref: S1748
Type: ED
Blank: BLADE
Mat: CHERT
Dim: 12x6x2
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A

Edge Angle: acute

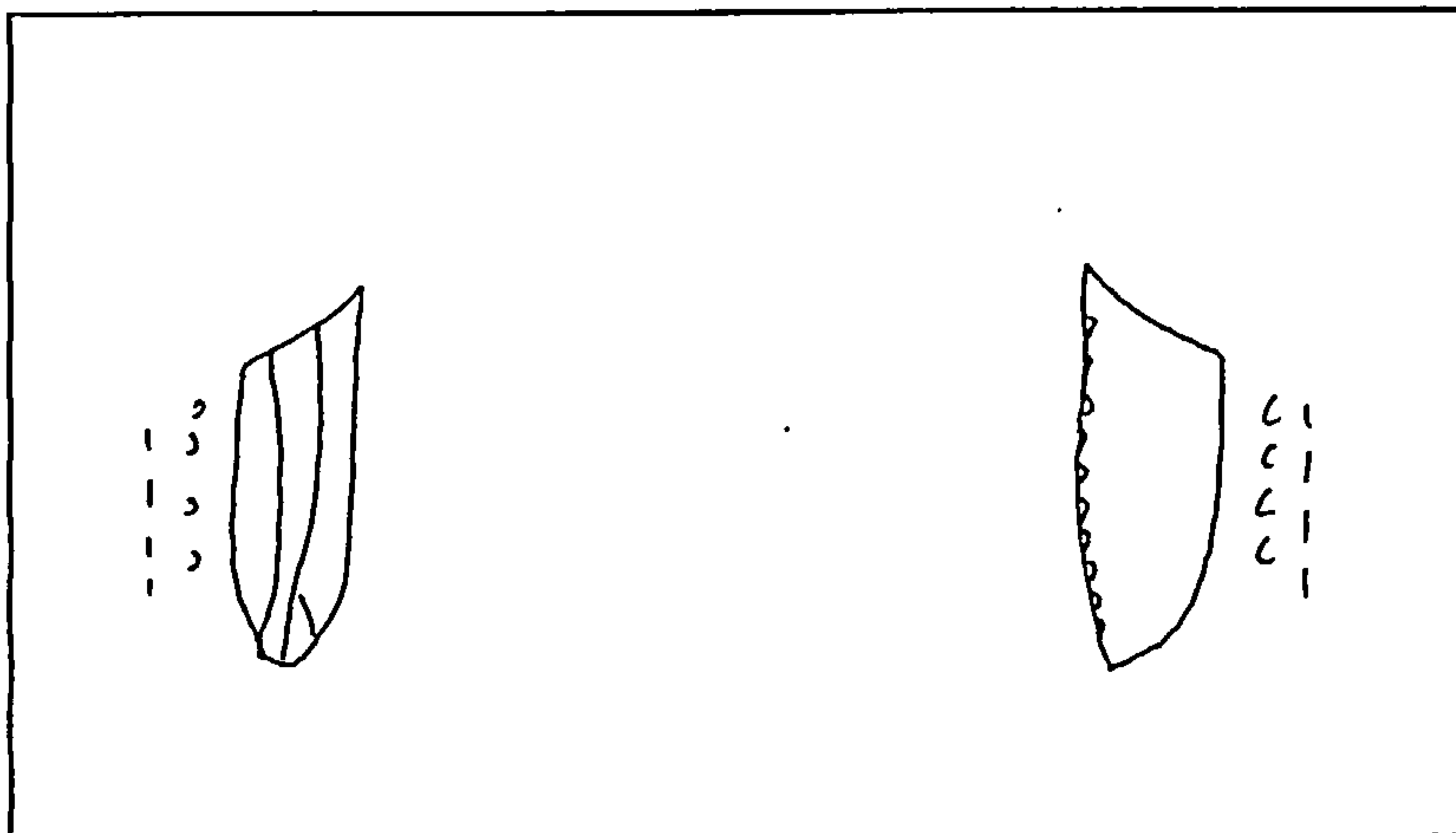
Traces:

Dorsal side a: rare clustered large to medium mostly feather terminating mixed scars. Associated with bright streaks and polish A: patchy (linear) along edge. Polish is smooth invasive, partially linked, with gradual edges and no internal features.

Ventral side a: Frequent clustered large to medium deep scars associated with A and B: broad spread along edge. Polish is rough reticulated, partially linked, with gradual edges and no internal features.

Interpretation: side a used
Comments:

Ref: S1750
Type: ED
Blank: BLADE
Mat: CHERT
Dim: 15x7x2
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A

Edge Angle: medium

Traces:

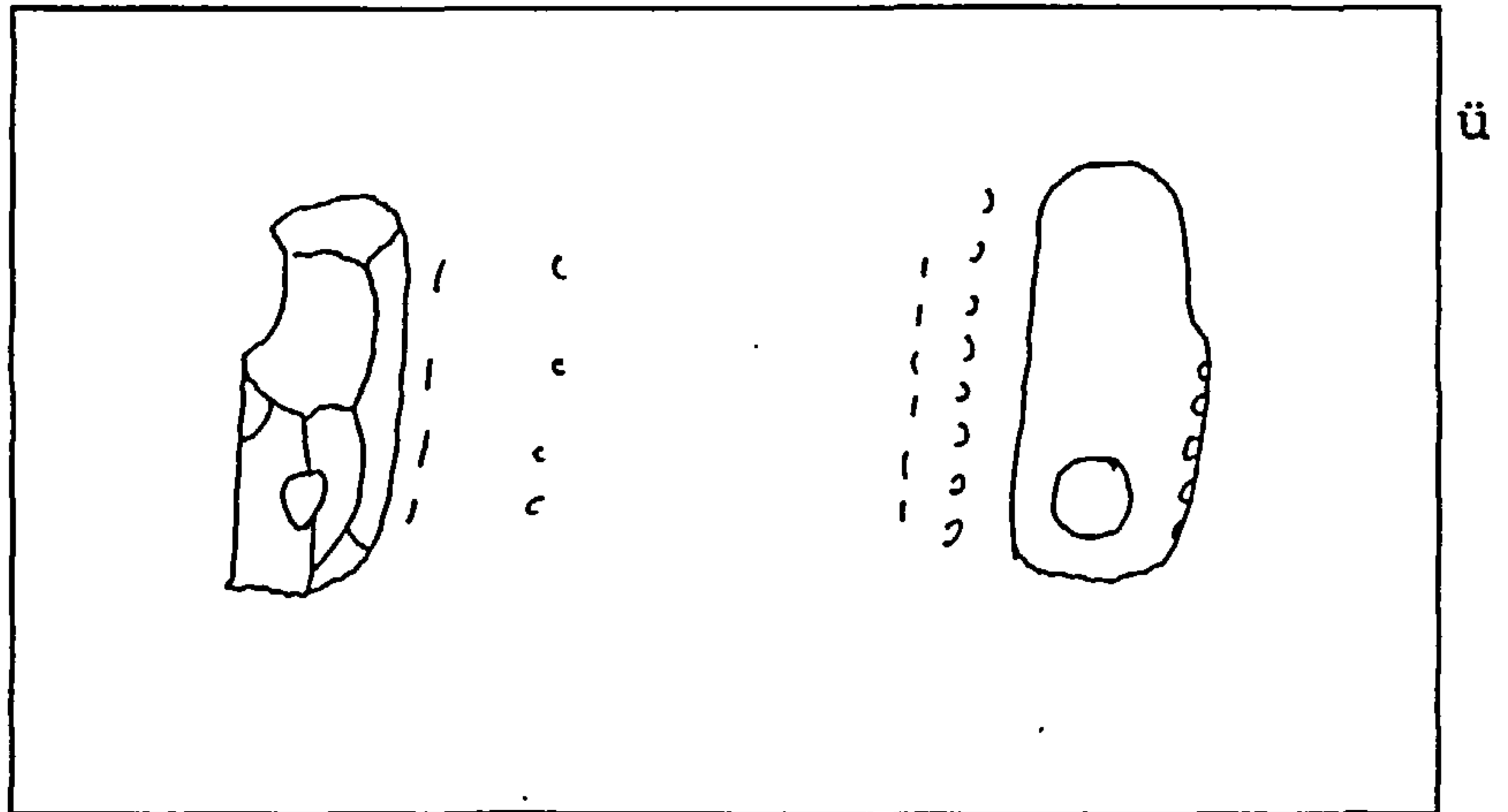
All traces on dorsal, similar but less
common/developed traces on ventral.

Side a: frequent clustered medium to small mostly
step terminating deep scars associated with patchy
polish along edge. Polish is smooth invasive
partially linked, with gradual edges and no internal
features.

Interpretation: prob used

Comments: either polish or edge damage on their own would
have to be dismissed, combined they make the case for use
more convincing

Ref: S1752
Type: ED
Blank: BLADE
Mat: FLINT
Dim: 21x10x3
Qual: EXC
Cond: BURNT



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A

Edge Angle: medium

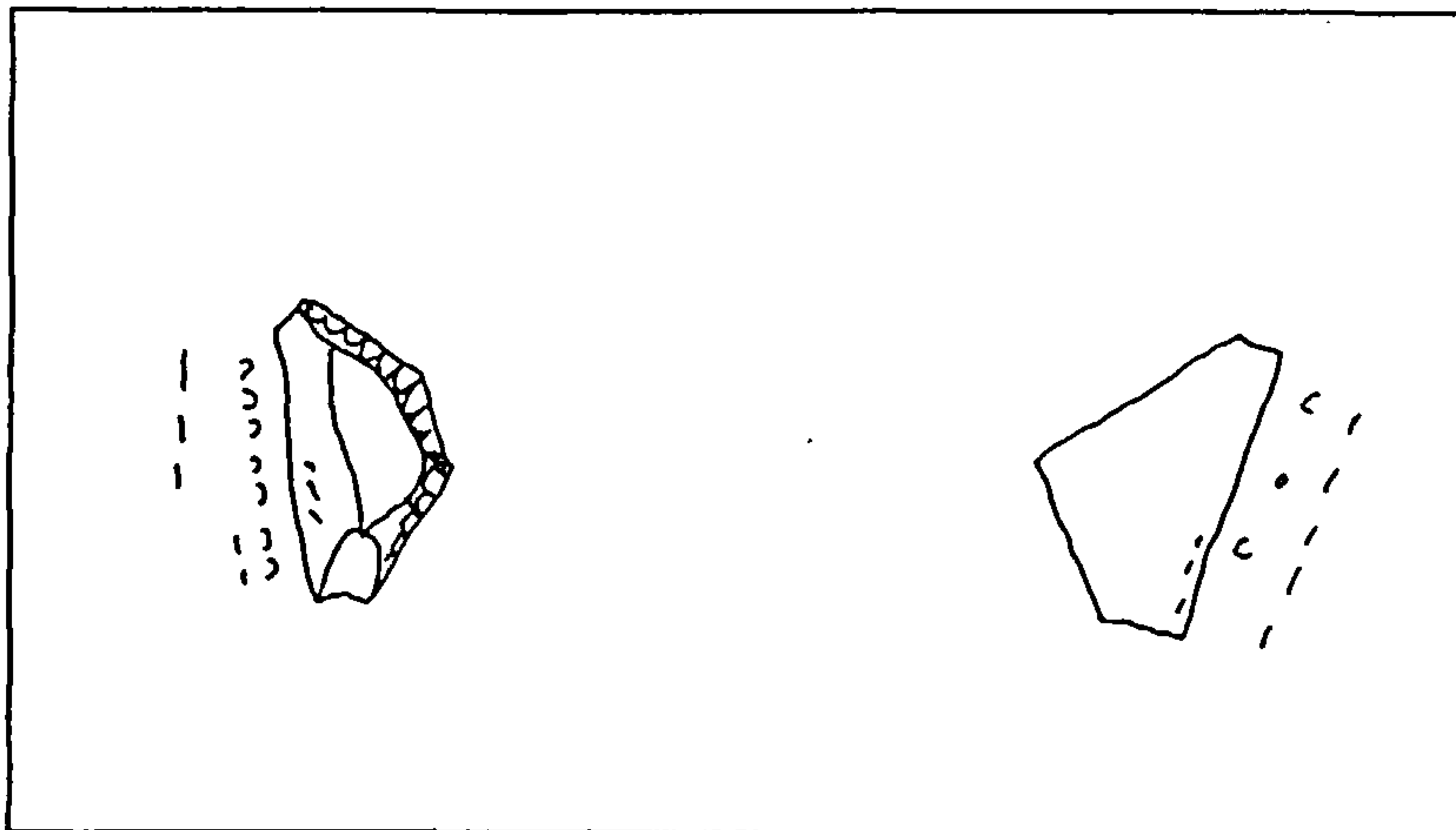
Traces:

Dorsal side b: occasional scattered medium to small mostly step terminating mixed scars associated with a restricted narrow linear polish along edge. Polish is smooth domed, allover, developed, with sharp edges and occasional minute irregular pits.

Ventral side b: Frequent clustered medium to small mostly step terminating mostly deep scars associated with restricted patches of polish away from edge. Polish is smooth domed, allover, developed, with sharp edges and occasional minute irregular pits. Also with broad spread of polish along edge. Polish is rough reticulated, partially linked, with gradual edges and no internal features.

Interpretation: side b used, probably transverse
Comments: difficult because of burning effects

Ref: S1754
Type: MICRO
Blank: BLADE
Mat: FLINT
Dim: 12x6x2
Qual: GOOD
Cond: PATINA



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: medium

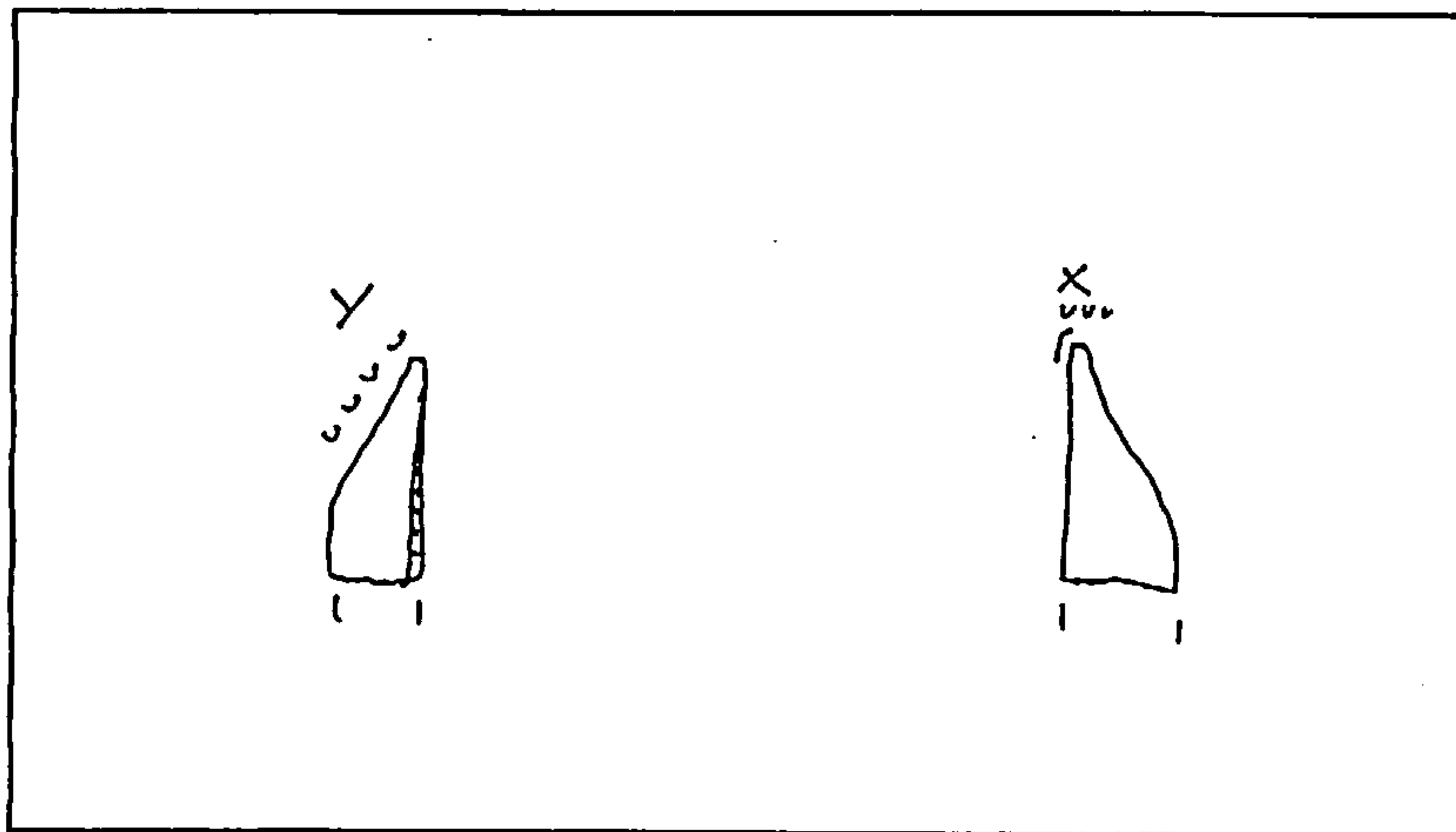
Traces:

Dorsal side a: common clustered small mixed termination deep scars, associated with restricted linear polish away from the edge at 45°. Polish is smooth flat, partially linked, developed, with abrupt edges and rare small irregular pits. Also with broad spread along edge. Polish is smooth flat reticulated, scattered, developed, with abrupt edge and no internal features.

Ventral side a: occasional scattered medium to small feather terminating deep scars associated with broad spread along edge. Polish is smooth flat reticulated, scattered, developed, with abrupt edge and no internal features. Also with broad spread along edge. Polish is smooth reticulated, scattered, poor, with gradual edges and no internal features.

Interpretation: side b used
Comments:

Ref: S1755
Type: MICRO
Blank: BLADE
Mat: FLINT
Dim: 7x3x2
Qual: GOOD
Cond: SP



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: point

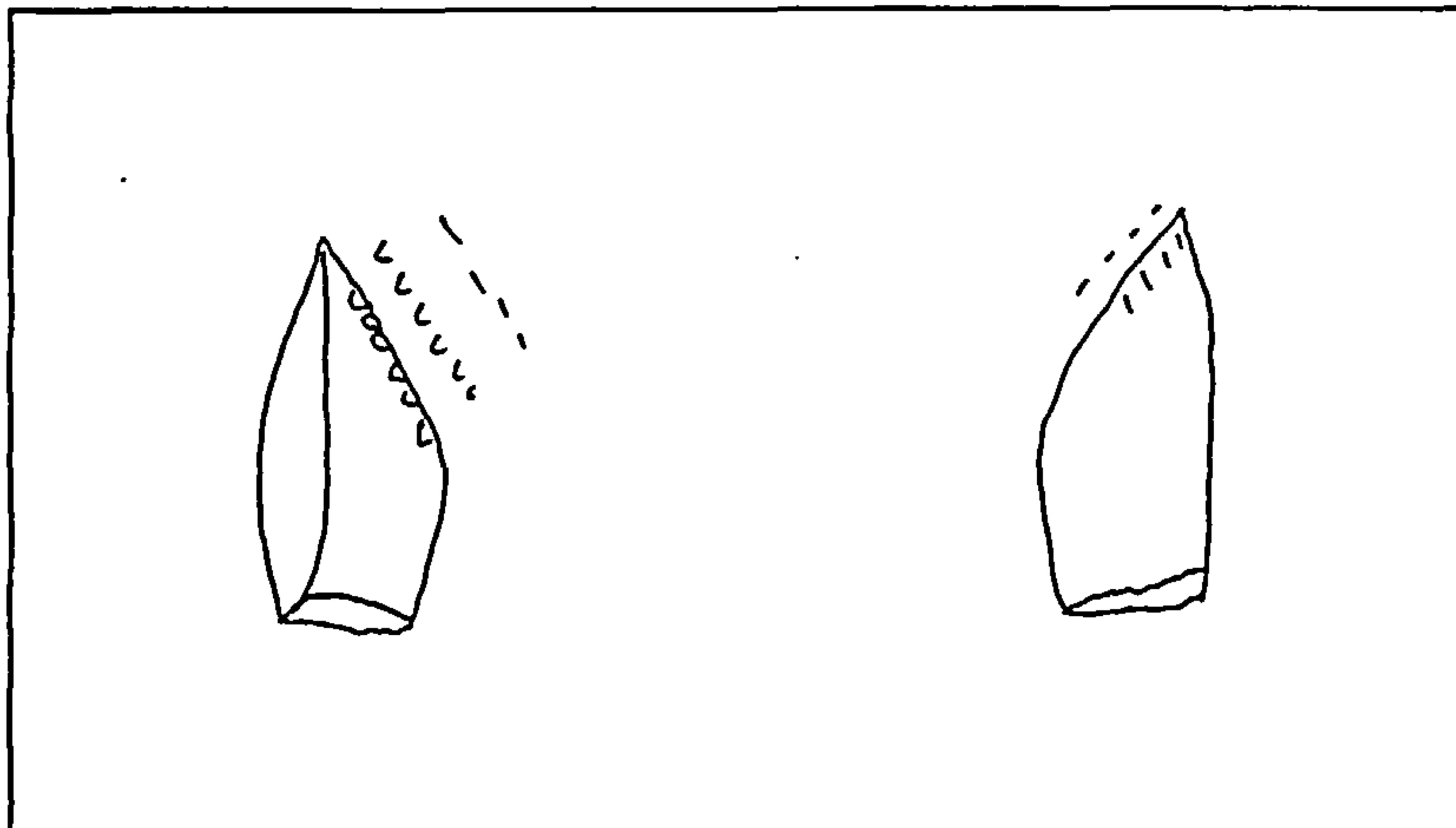
Traces:

At X: common clustered and layered minute (with rare medium) mostly feather terminating shallow scars, associated with restricted narrow linear polish along edge. Polish is smooth domed and invasive, allover, developed, with gradual edges and frequent small circular pits.

At Y: regular clustered and layered medium mostly step terminating deep scars.

Interpretation: point used
Comments:

Ref: S1758
Type: ED
Blank: FLAKE
Mat: CHERT
Dim: 16x9x4
Qual: MED
Cond: BURNT



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
O

Edge Angle: acute

Traces:

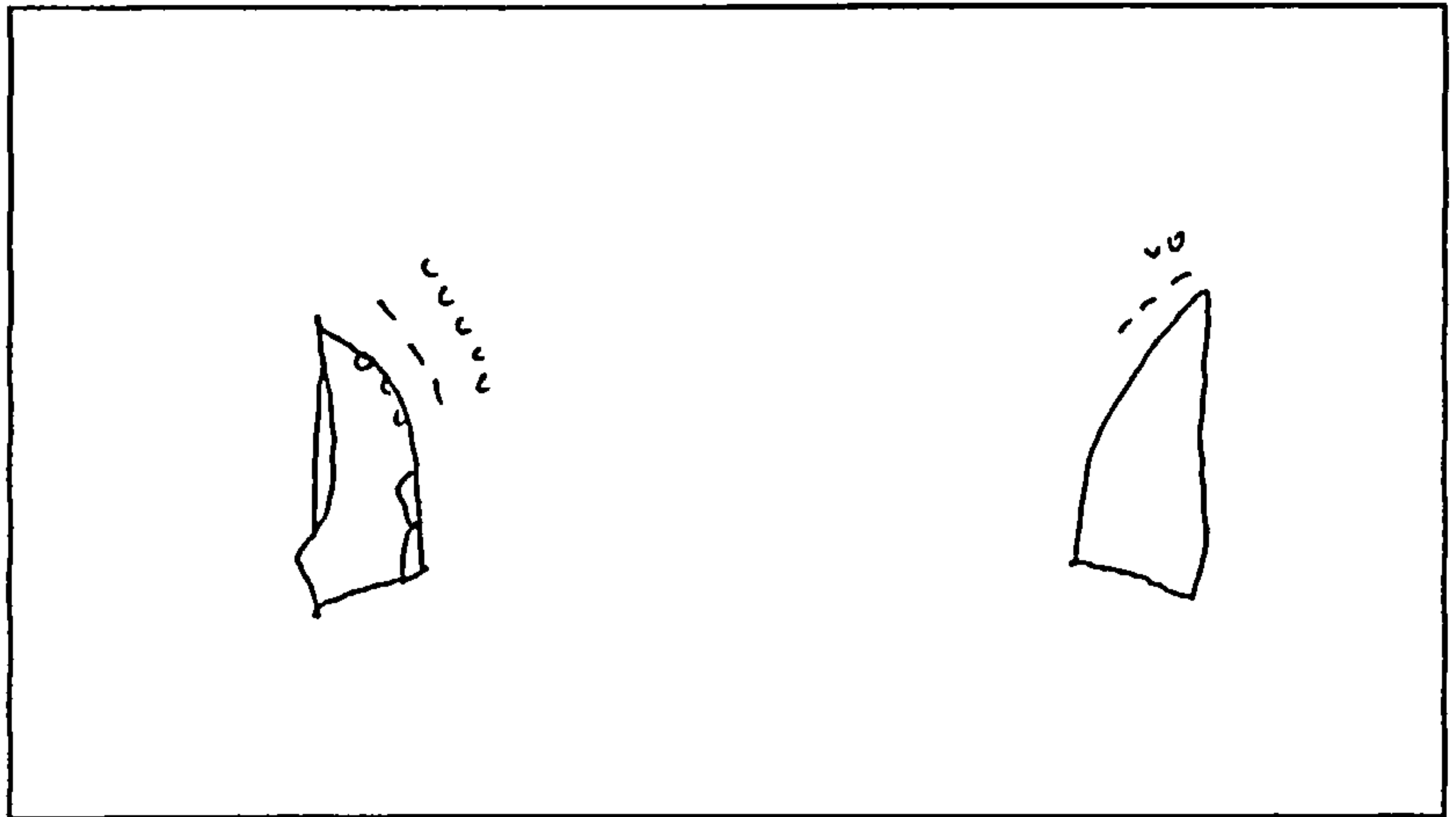
Dorsal side b: frequent clustered small mostly feather terminating mostly deep scars associated with a patchy polish on the edge. Polish is smooth domed, partially linked, developed, with sharp edges and common small circular pits.

Ventral side b: no edge damage. Patchy polish on and away from edge. Polish is smooth flat, allover, developed, bright, with abrupt edges and occasional medium irregular pits. Also with patchy polish on edge. Polish is smooth flat, developed, with abrupt edges and frequent minute circular pits. Associated random long deep striations.

Interpretation: Side b used.

Comments: very clear despite burning

Ref: S1764
Type: ED
Blank: FLAKE
Mat: CHERT
Dim: 10x6x2
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: V Crys: O Topo: F Fissures:
O

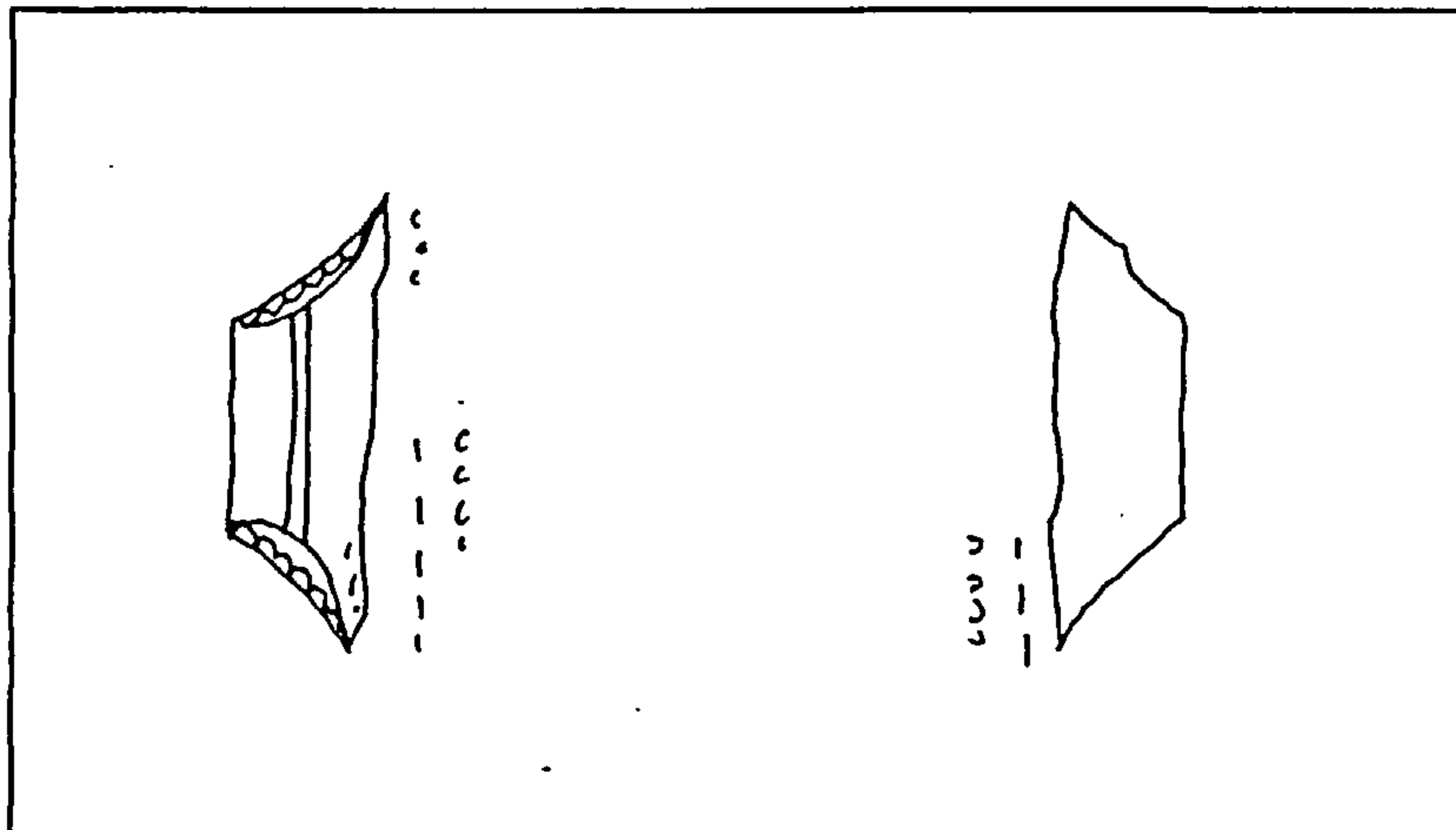
Edge Angle: acute

Traces:

Side b, both sides similar. occasional clustered small mixed termination mostly deep scars, associated with restricted patchy polish on edge. Polish is smooth invasive, partially linked, with gradual edges and rare medium irregular pits. Alos on dorsal face only restricted patchy polish on edge. Polish is smooth domed with gradual edges and occasional small irregular pits.

Interpretation: side b opp use. Long motion
Comments: just side of tip used

Ref: S1765
Type: MICRO
Blank: BLADE
Mat: FLINT
Dim: 23x7x2
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures: A

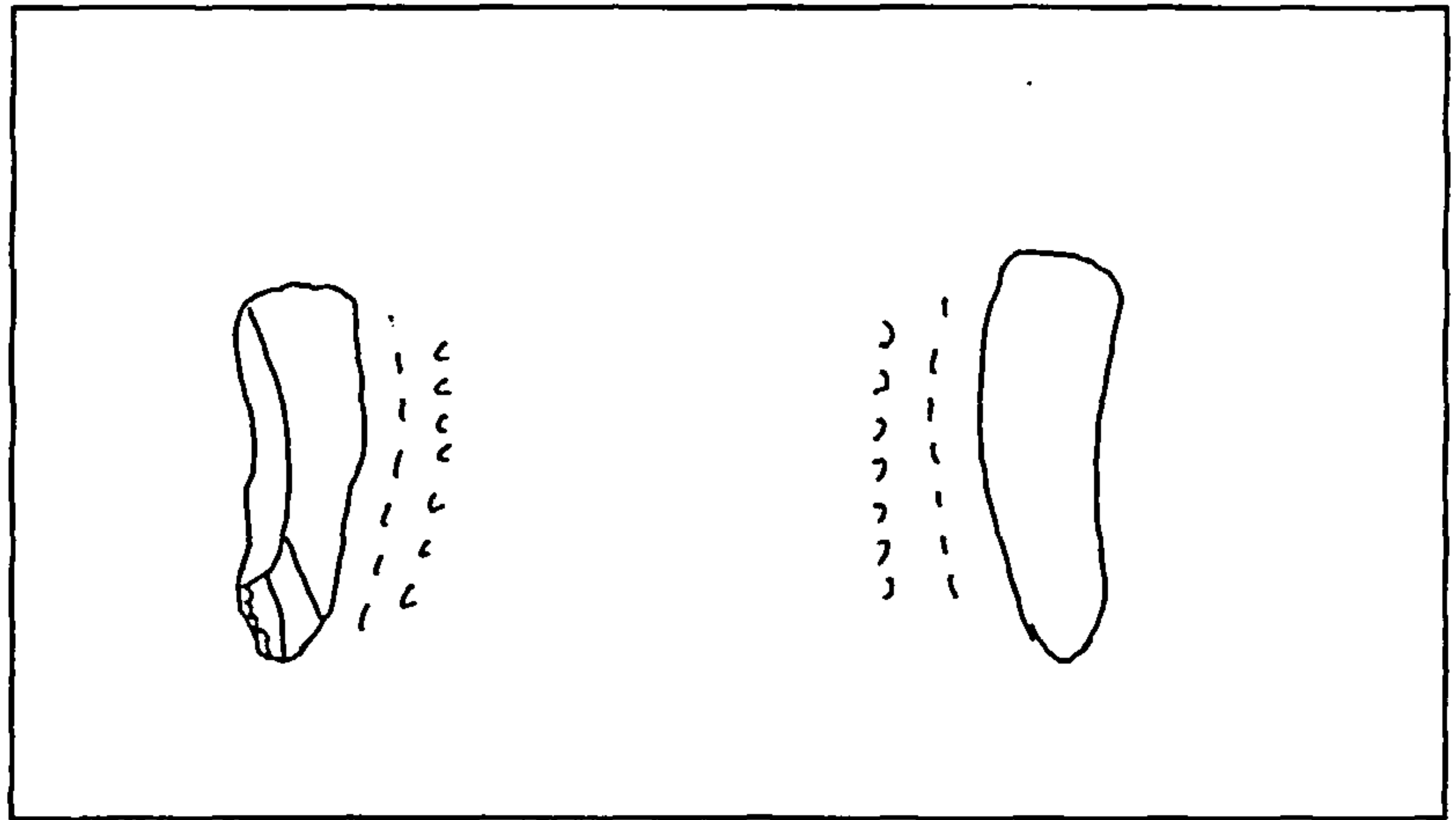
Edge Angle: acute

Traces:

Side b, both faces nearly identical: frequent clustered large to medium mostly step terminating deep scars, good bidirectional evidence, associated with broad spread of polish along edge. Polish is smooth flat, scattered, developed, with abrupt edges and common minute irregular pits. On ventral alos patchy spread away from edge. Polish is smooth flat, allover, intense, with abrupt edges and common small irregular pits. Associated with parallel long deep fine numerous striations.

Interpretation: side b used. Long motion, bidirectional
Comments:

Ref: S1768
Type: ED
Blank: BLADE
Mat: FLINT
Dim: 18x8x2
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A

Edge Angle: acute

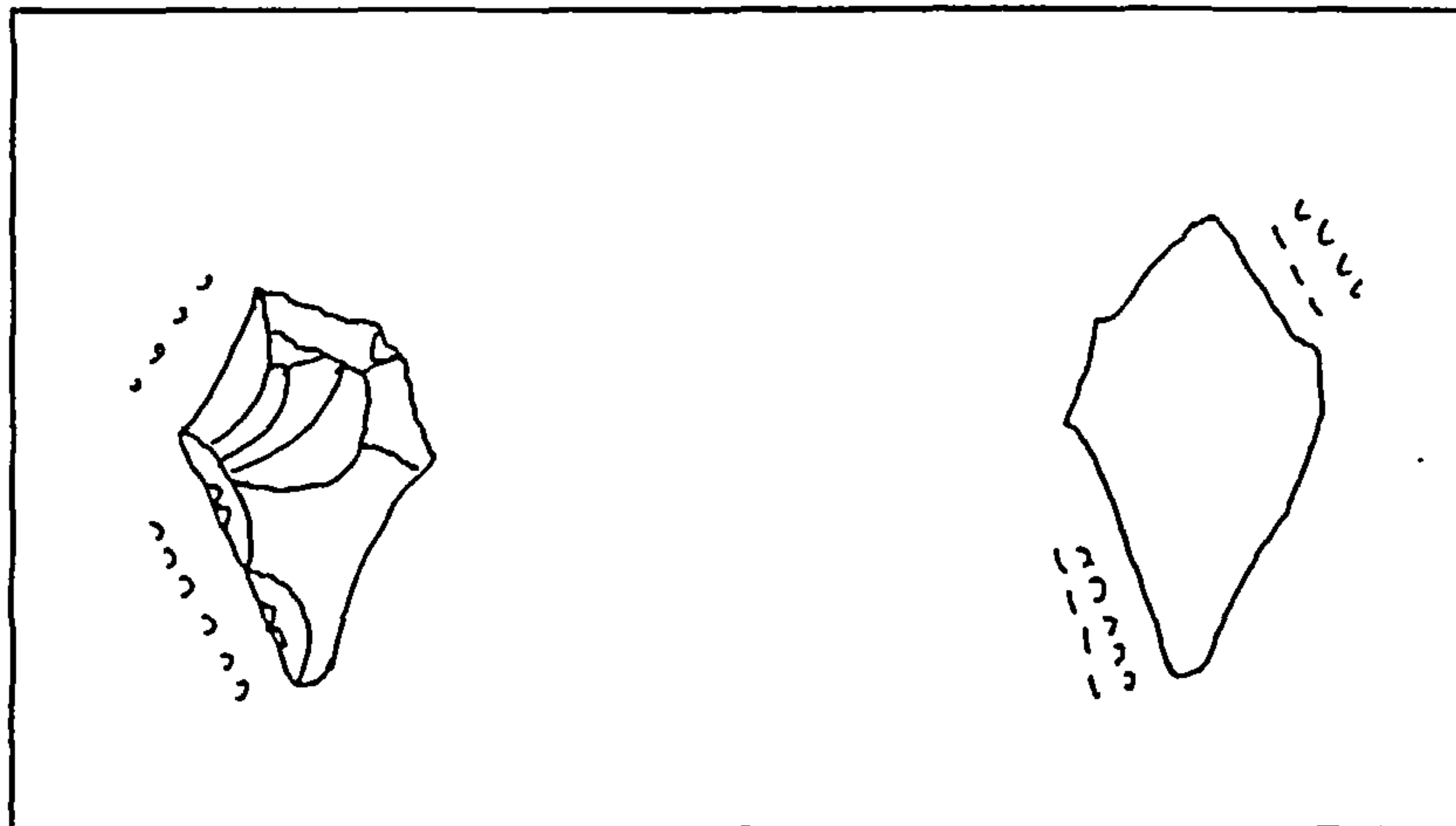
Traces:

Side b, both faces very similar: frequent to numerous clustered minute mostly feather terminating mostly deep scars with snaps, some bidirectional signs, associated with patchy (narrow linear) polish along edge. Polish is smooth invasive, partially linked, developed, variable, with fairly sharp edges and occasional medium irregular pits.

Interpretation: side b used, long motion, pos
bidirectional, light work

Comments:

Ref: S1773
Type: ED
Blank: FLAKE
Mat: CHERT
Dim: 23x17x4
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: a = thick, b = medium

Traces:

Dorsal a: numerous clustered small step terminating scars.

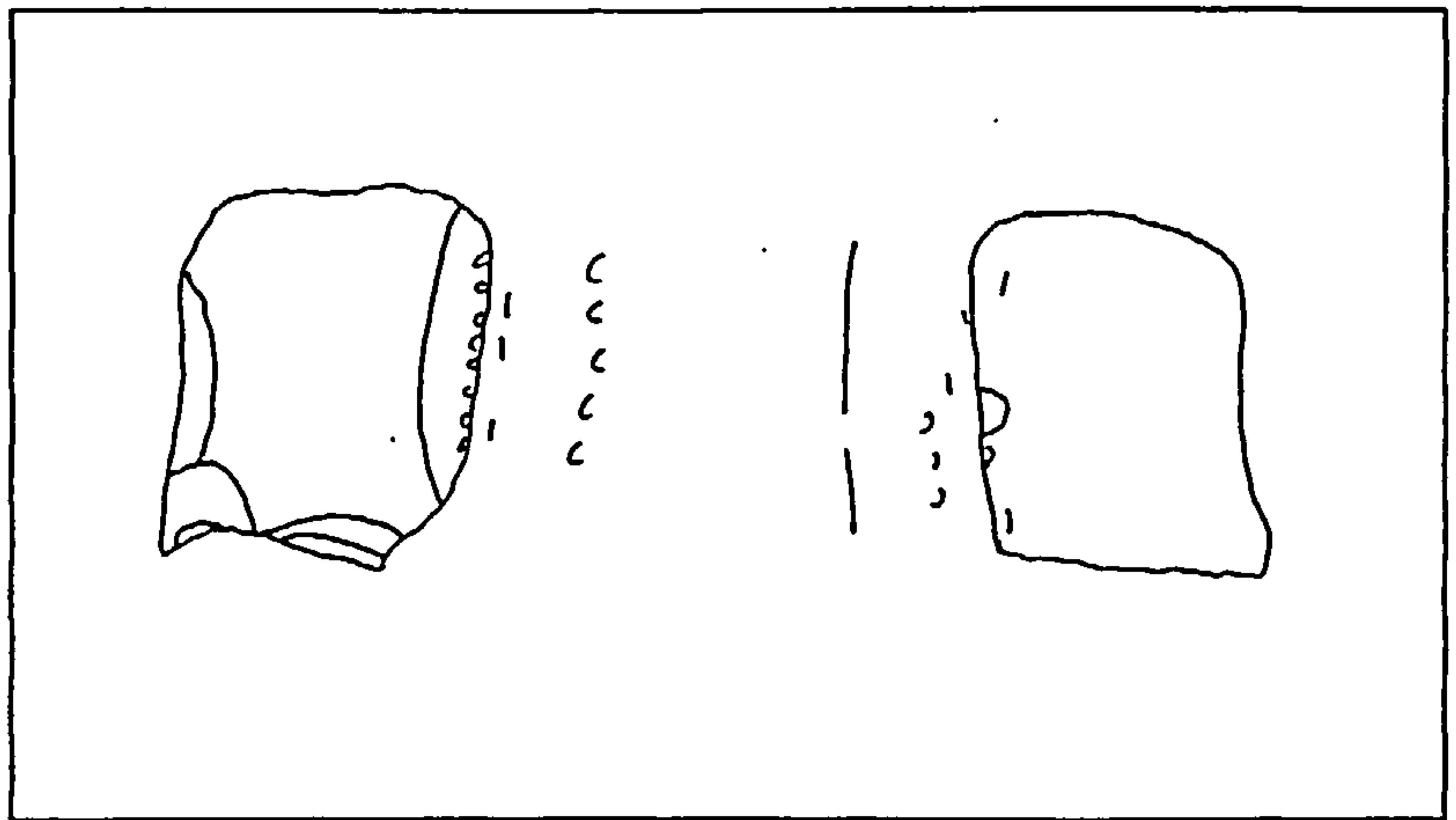
Ventral a: common clustered small mixed termination mostly deep scars with snaps, associated with patchy polish on edge. Polish is smooth domed and invasive, allover, developed, variable, with gradual edges and occasional medium irregular pits.

Ventral b: Common clustered small mostly step terminating mostly shallow scars, associated with patchy polish on the edge. Polish is smooth domed invasive, developed with gradual edges and frequent small circular pits.

Interpretation: used

Comments: difficult, piece obviously heavily battered

Ref: S1774
Type: ED
Blank: FLAKE
Mat: FLINT
Dim: 20x20x4
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures: A

Edge Angle: medium

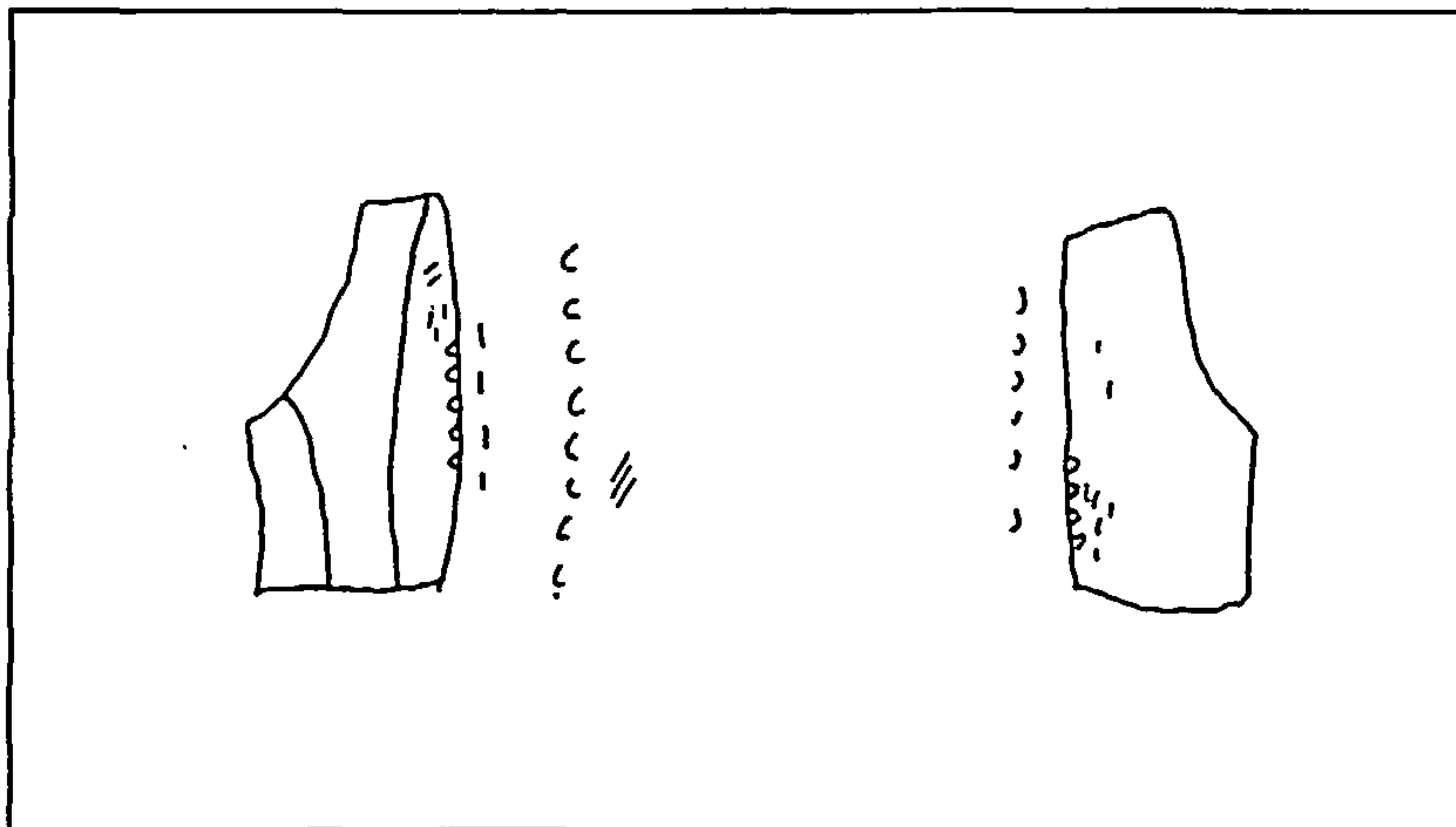
Traces:

Dorsal side b: frequent to numerous clustered and layered large step terminating deep scars, associated with patchy polish on edge. Polish is smooth flat reticulated, scattered, with sharp edges and common minute circular pits.

Ventral side b: Occasional clustered large mostly feather terminating mostly shallow scars, associated with A: restricted patchy polish away from the edge. Polish is smooth flat developed bright with abrupt edges and no internal features. Also with B: linear patchy polish along edge. Polish is smooth domed, partially linked, with soft edges and frequent minute circular pits. Also with D: restricted linear polish along the edge. polish is smooth domed, allover, developed, bright, with gradual edges and occasional minute circular pits. Forms a very well developed edge bevel

Interpretation: side b used. transverse use
Comments:

Ref: S1777
Type: ED
Blank: FLAKE
Mat: FLINT
Dim: 20x15x3
Qual: ESC
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: acute

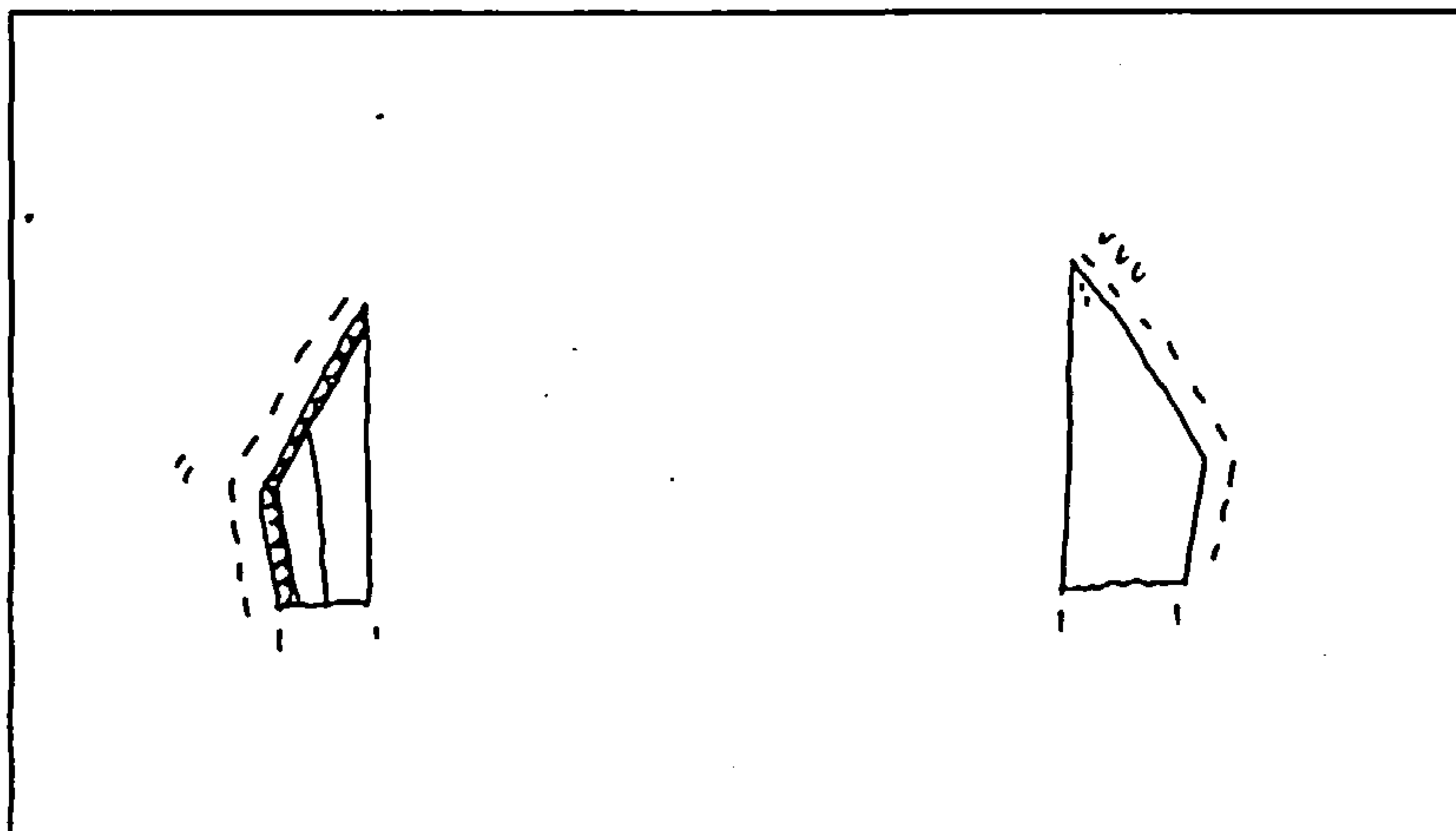
Traces:

Side b, both sides very similar: common clustered large to medium mostly step terminating mostly shallow scars, associated with A: patchy polish away from the edge. Polish is smooth flat, scattered, developed, bright, with abrupt edges and no internal features. Also B: Patchy linear (45o) polish away from the edge. Polish is smooth flat, partially linked, developed, bright, and abrupt edges with no internal features. Also C: restricted linear polish along edge. Polish is smooth domed, with abrupt edges and common medium irregular pits, associated with perpendicular short, deep, narrow and fine, frequent striations. Also D: patchy polish on the edges. Polish is smooth, flat/domed, developed, bright, rare small mixed irregular pits. Associated with 75o perpendicular short medium narrow striations.

Interpretation: side b used, probably long motion

Comments: scars and polish suggest long motion, although striations suggest transverse.

Ref: S1778
Type: MICRO
Blank: BLADE
Mat: FLINT
Dim: 12x5x2
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: thick

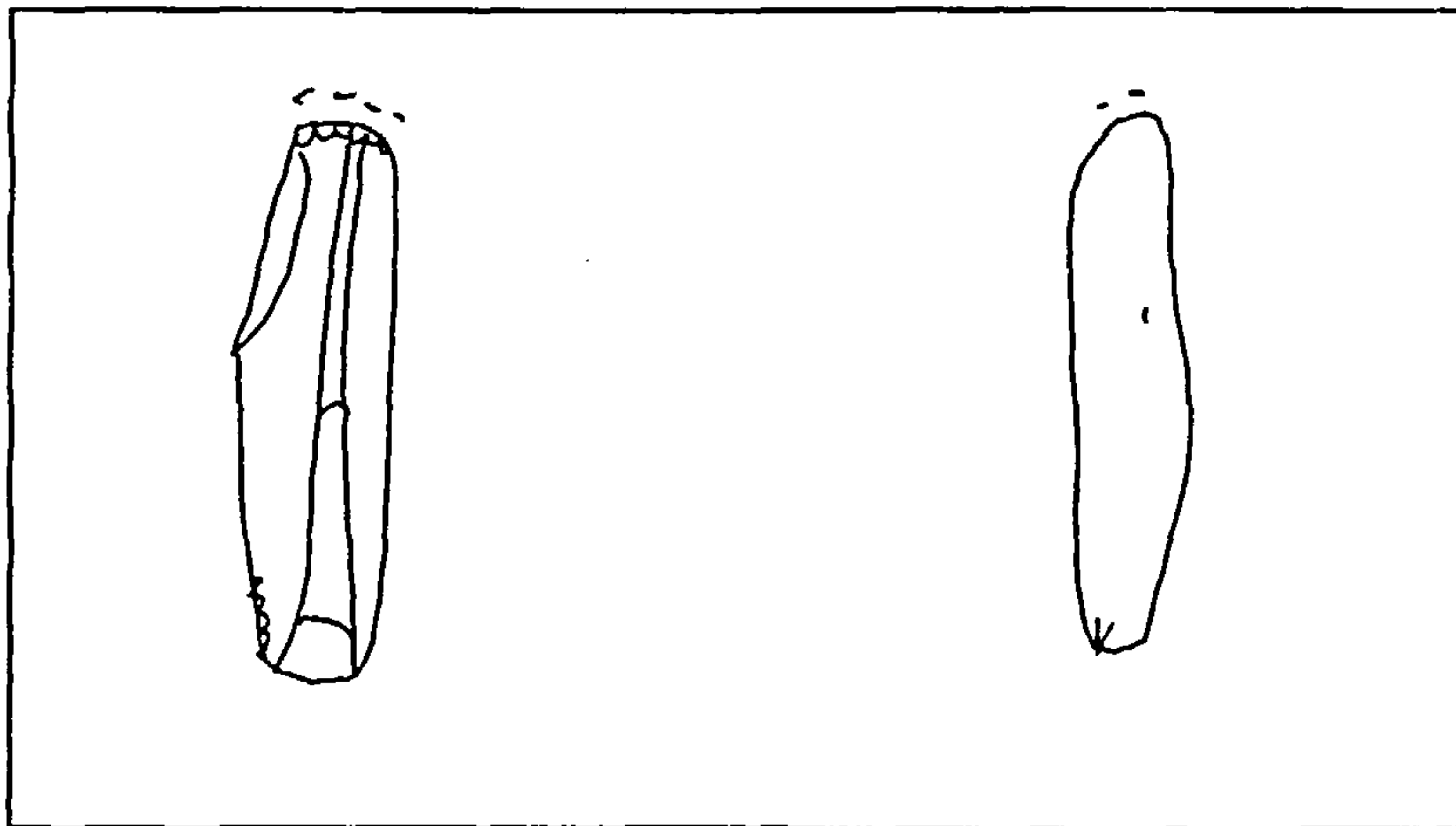
Traces:

Dorsal side a: edge damage impossible because of retouch. Restricted narrow linear polish along edge. Polish is smooth domed, allover, developed, with gradual edges and occasional small and minute circular pits. Associated with parallel short deep narrow cross/random rare striations on protruding corner.

Ventral side a: occasional clustered minute mostly feather terminating deep scars, concentrated near tip, associated with a restricted patchy polish away from edge. Polish is smooth domed and invasive, scattered, developed, with gradual edges and frequent small circular pits. Also with a restricted narrow linear polish along the edge. Polish is smooth invasive, partial, with sharp edges and occasional small circular pits.

Interpretation: side a used, leading with point
Comments:

Ref: S1779
Type: ED
Blank: BLADE
Mat: FLINT
Dim: 33x8x3
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures: A

Edge Angle: thick

Traces:

Dorsal distal end: edge damage impossible to record because of retouch and associated crushing.

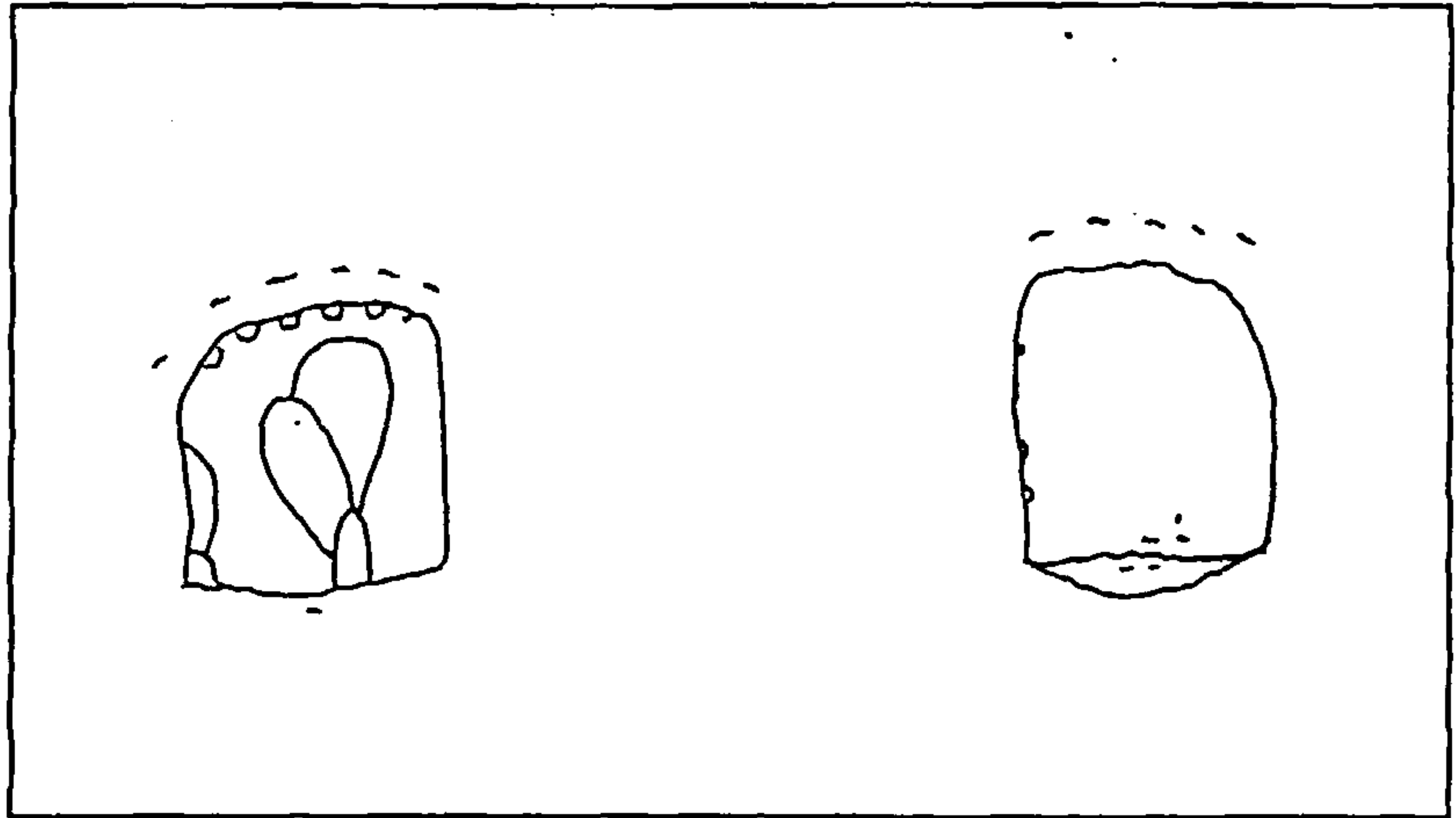
Restricted narrow linear polish away from the edge along ridges. Polish is smooth domed, partially linked, developed, bright, with gradual edges and occasional small irregular pits.

Ventral distal end: no edge damage. Patchy polish on interior. Polish is smooth domed and invasive, allover, developed, bright, with abrupt edges and frequent small circular pits. Also restricted patchy polish on and away from edge. Polish is smooth flat, developed, with abrupt edge and occasional small irregular pits.

Interpretation: distal end used. Transverse motion. light work

Comments:

Ref: S1786
Type: ED
Blank: FLAKE
Mat: FLINT
Dim: 12x15x4
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures: A

Edge Angle: thick

Traces:

Edge damage impossible to record, due to retouch

Dorsal distal: Polish B: broad spread away from edge. Polish is smooth invasive, partially linked, variable, with gradual edges and no internal features. Also polish D: Broad spread away from and on edges. Polish is smooth domed invasive (some flat fluid infilling), partially linked, with gradual edges and common small circular edges.

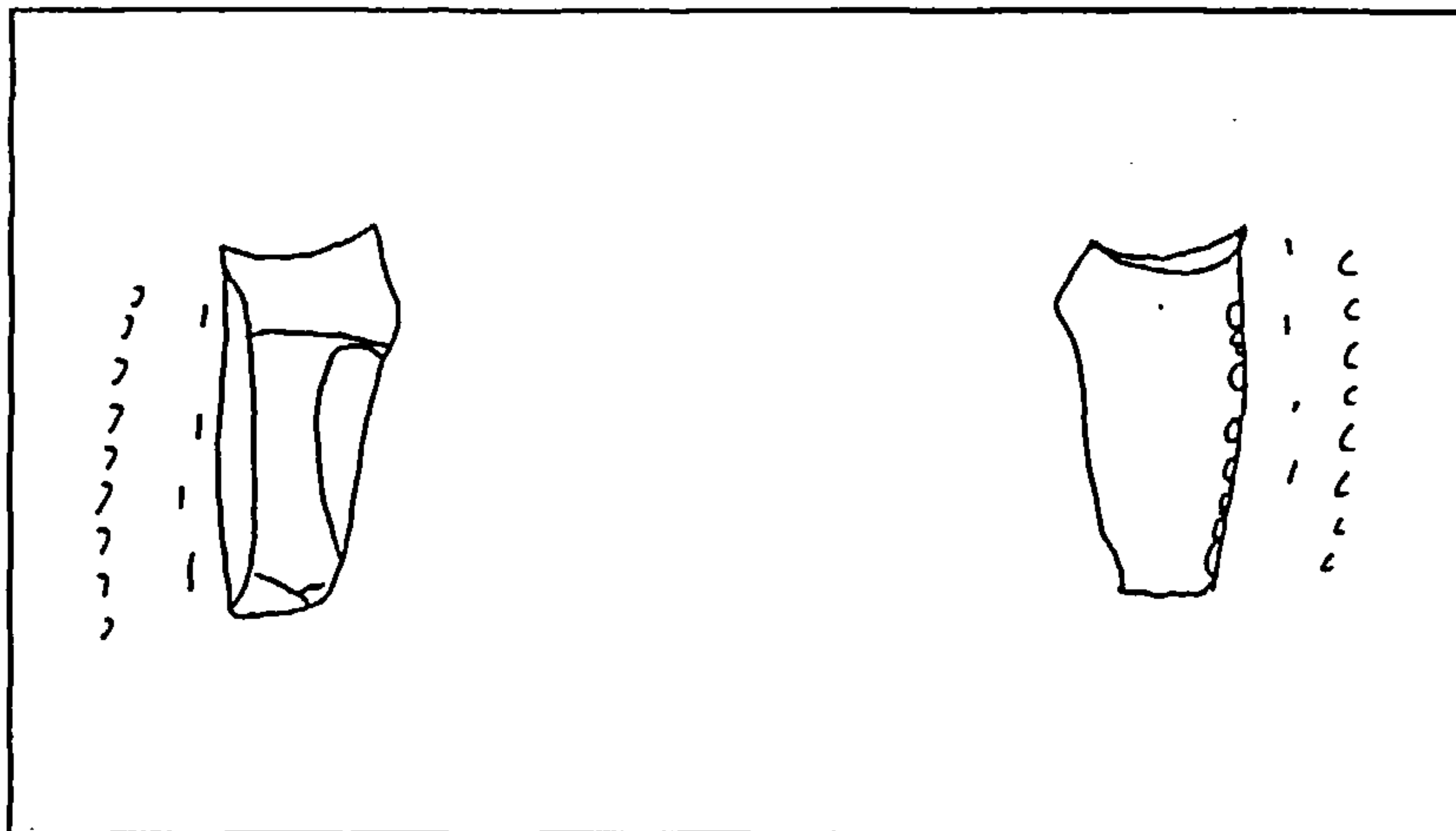
Ventral distal: Polish B, but located on the edge.

Various traces near break at proximal.

Interpretation: distal end used

Comments: traces near "proximal" end - possibly the result of a high pressure break during use.

Ref: S1787
Type: ED
Blank: FLAKE
Mat: CHERT
Dim: 25x14x4
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: V Crys: O Topo: F Fissures:
A

Edge Angle: medium

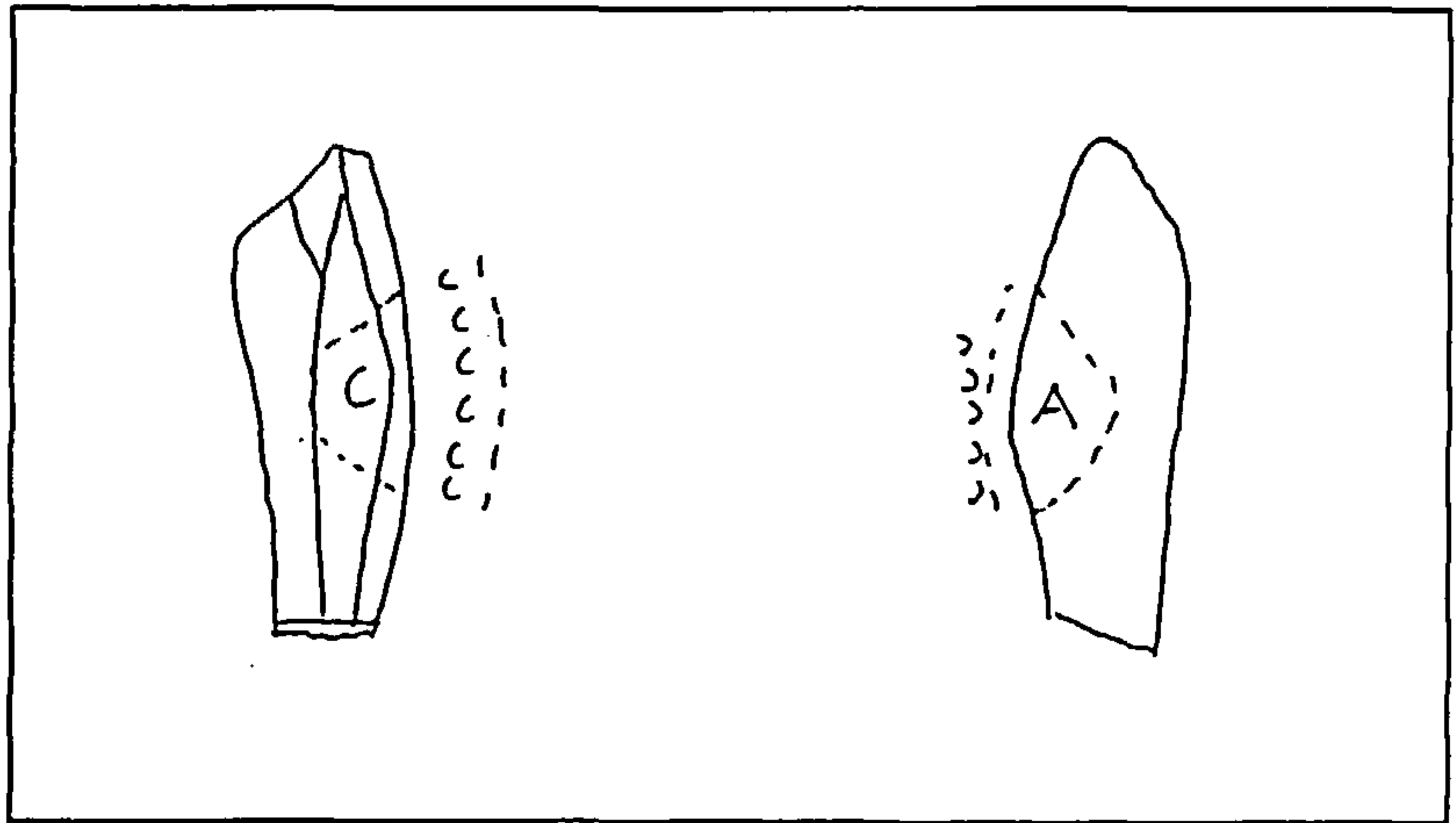
Traces:

Side a, both faces: common clustered and layered medium (with minute edge row) mostly step terminating mostly deep scars associated with patchy narrow linear along and away from edge. Polish is rough flat, partially linked, developed, variable, with sharp edges and frequent variable irregular pits. Associated with parallel short deep narrow striations. Also (just on dorsal) restricted patchy polish on and away from edge. polish is smooth invasive, scattered, with sharp edges and occasional small irregular edges. Also (just on dorsal) broad spread along and away from edge. Polish is rough reticulated, scattered, poor, variable, with gradual edges and no internal features.

Interpretation: side a used, long motion, soft material

Comments: Differential traces explained by cross section

Ref: S1789
Type: ED
Blank: BLADE
Mat: FLINT
Dim: 34x12x4
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures: A

Edge Angle: thick

Traces:

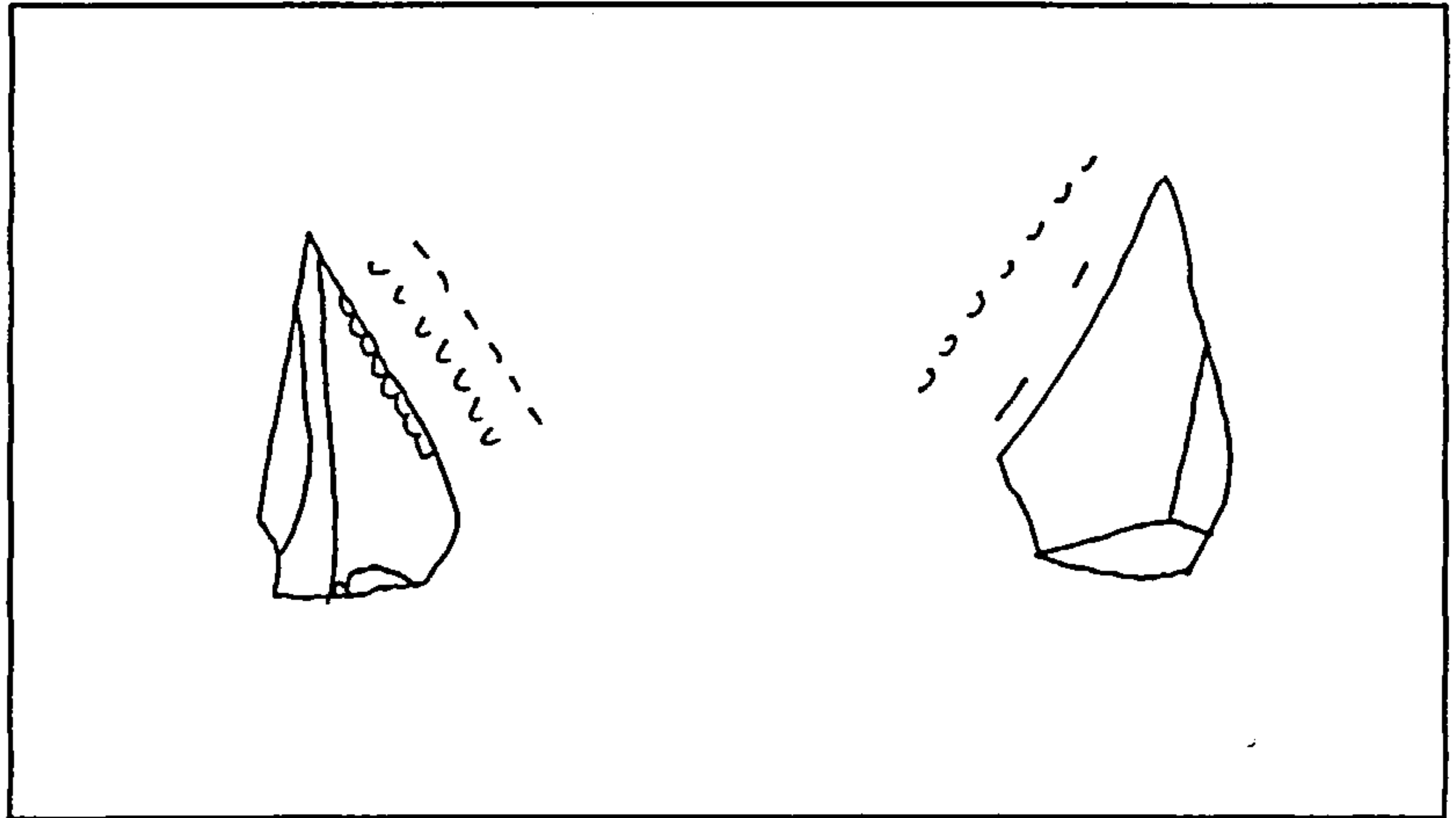
Dorsal side b: frequent clustered small to minute mostly step terminating deep scars, associated with A: very broad spread. Polish is smooth flat, partially linked, intense, bright, with sharp edges and common medium irregular pits. Associated with 450 to 750 long to medium deep variable frequent striations. Also B: patchy polish on edge. Polish is smooth flat reticulated, partially linked, developed, with sharp edges and occasional medium irregular pits. Also C: broad spread away from edge and on interior. Polish is smooth flat (rippled), allover, intense, bright, with abrupt edges and occasional medium irregular pits. Covered with random striations

Ventral side b: occasional clustered large step terminating deep scars associated with A

Interpretation: side b used

Comments: found C in particular and have tried to remove it, with chemicals and by scalpel. Have failed so far.

Ref: S1791
Type: ED
Blank: FLAKE
Mat: CHERT
Dim: 17x9x4
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures: C

Edge Angle: acute

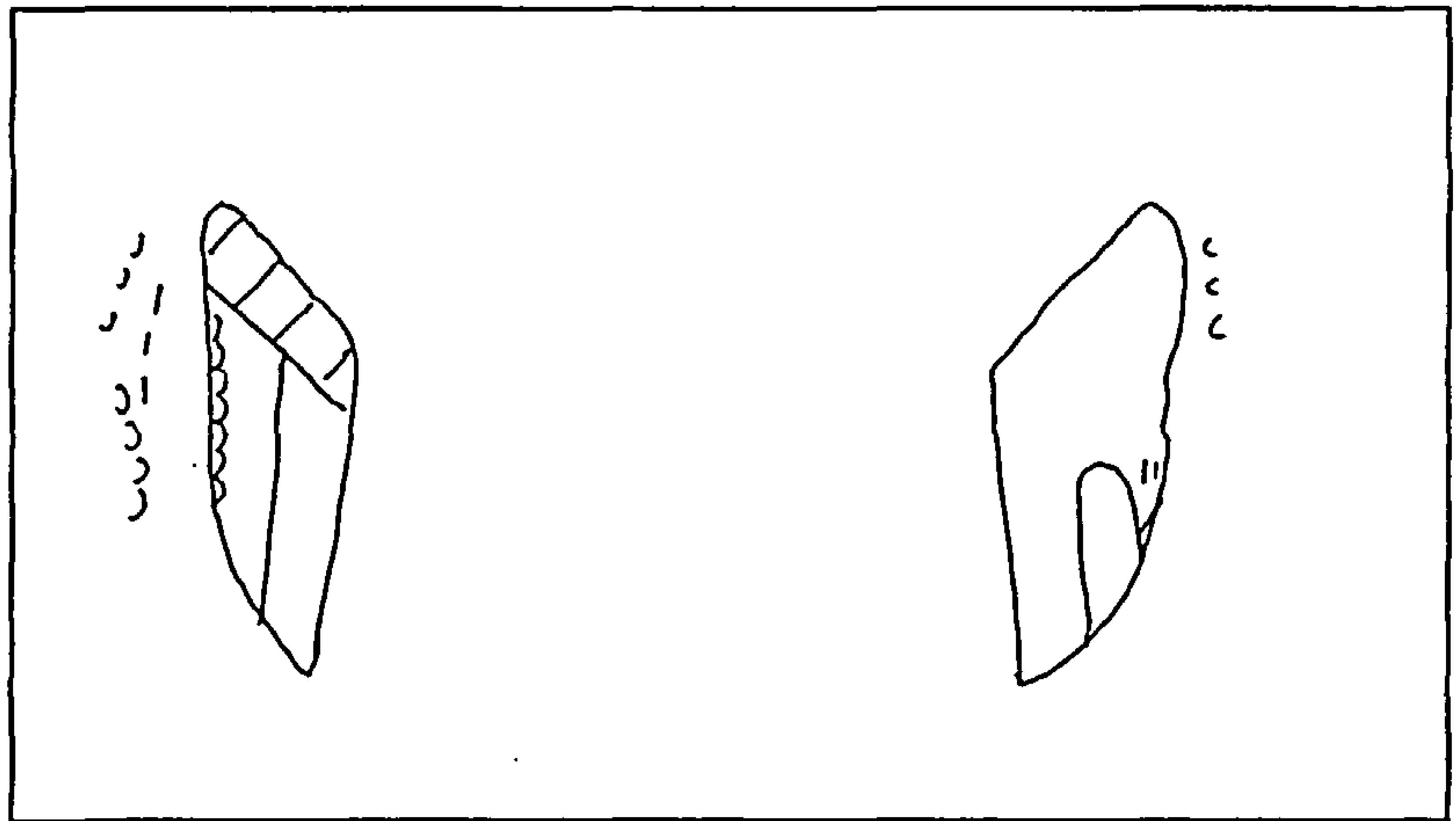
Traces:

Dorsal side b: regular clustered medium to small mostly feather terminating mostly deep scars associated with restricted patches on edge of rough invasive allover polish with gradual edges and occasional small circular pits. Also with a broad spread along and away from edge. Polish is smooth invasive, partially linked, poor, variable, with gradual edge and occasional small circular pits.

Ventral side b: common clustered small mostly feather terminating deep scars associated with restricted patches of polish on edge. Polish is smooth invasive, scattered, poor, variable with gradual edges and occasional small circular pits. Also with patches of ploish on and away from edge. Polish is smooth invasive, partially linked, with gradual edges and occasional small circular pits.

Interpretation: side b used, probably transverse
Comments:

Ref: S1793
Type: ED
Blank: BLADE
Mat: FLINT
Dim: 22x9x3
Qual: MED
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
O

Edge Angle: acute

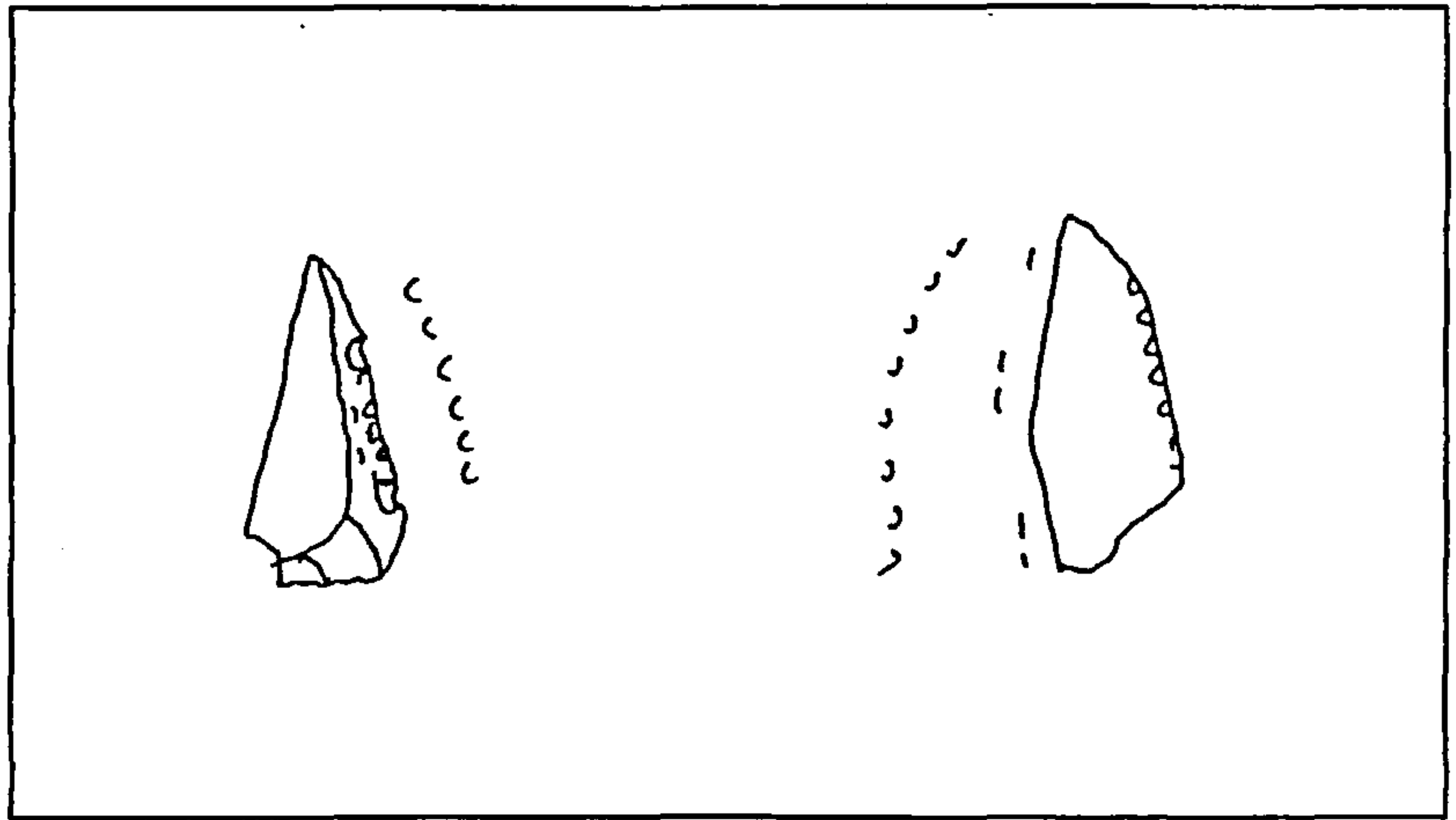
Traces:

Dorsal side a: occasional clustered small to minute mostly feather terminating deep scars associated with a restricted narrow linear polish along the edge. Polish is smooth flat reticulated, partially linked, with gradual edge and occasional medium irregular pits. Also with restricted narrow linear polish on extreme edge. Polish is smooth domed, allover, developed, bright, with sharp edges and frequent minute circular pits. Associated are parallel long deep narrow and fine striations.

Ventral side a: occasional clustered small to minute mostly feather terminating deep scars associated with a restricted linear polish away from edge, parallel to edge. Polish is smooth flat reticulated, partially linked, developed, bright, with sharp edges and no internal features. Associated are parallel long deep narrow and fine frequent striations.

Interpretation: side a used, long motion
Comments: differential polishing the result of differential contact because of section

Ref: S1794
Type: ED
Blank: BLADE
Mat: FLINT
Dim: 14x7x2
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: R Fissures:
A

Edge Angle: medium

Traces:

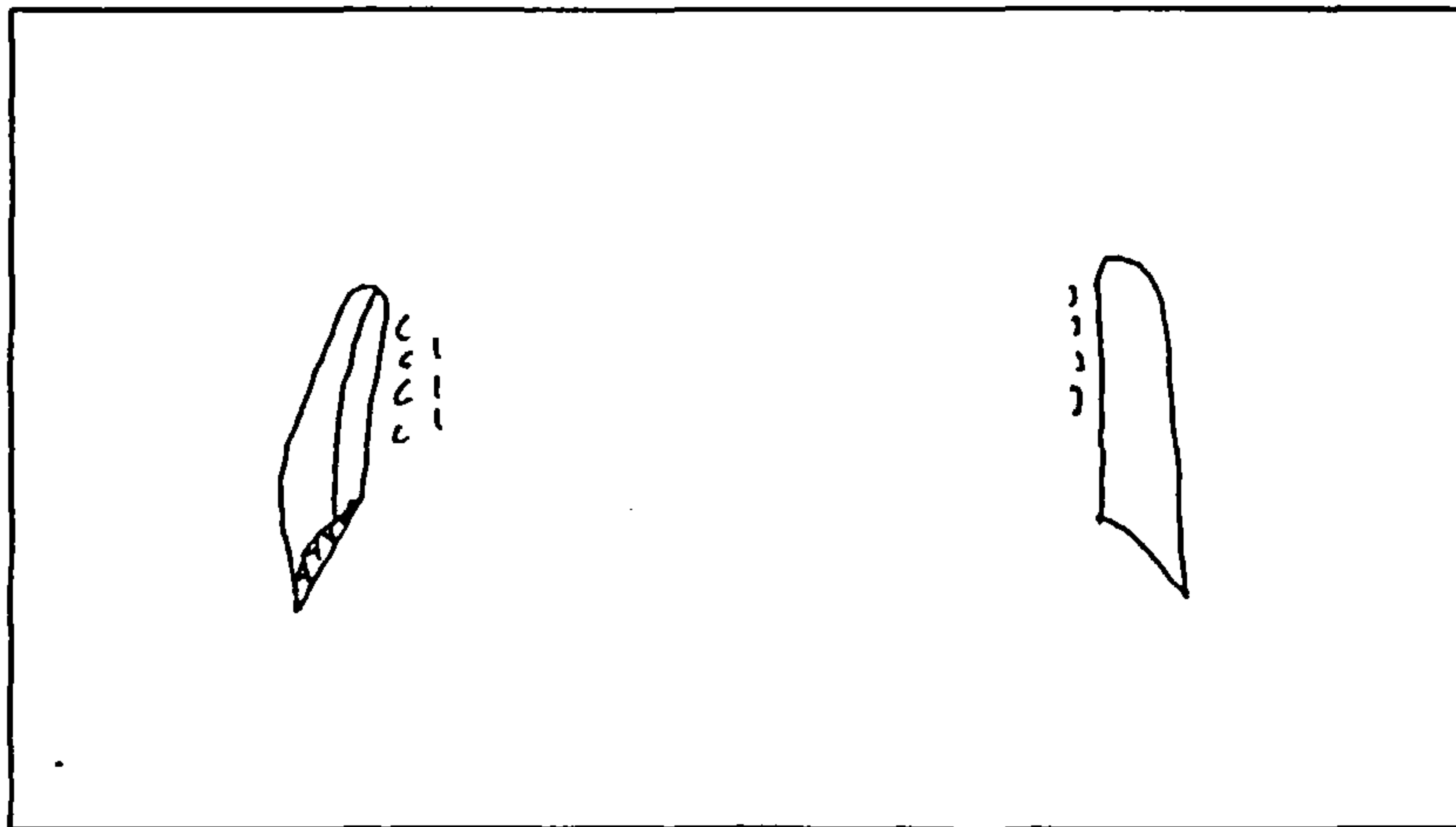
Dorsal side b: common clustered medium mostly feather terminating mixed scars associated with a restricted patchy polish away from the edge. Polish is smooth domed, partially linked, developed, with sharp edges and common small irregular pits.

Ventral side b: frequent clustered medium to minute mixed terminating deep scars , associated with patchy polish on edge. Polish is smooth domed, allover, developed, bright, with sharp edges and common small irregular pits. Also with patchy polish on edge. Polish is smooth reticulated, partially linked, developed, with sharp edges and no internal features.

Interpretation: side b used. Long motion

Comments: Section not symmetrical, explains variations in wear

Ref: S1835
Type: MICRO
Blank: BLADE
Mat: FLINT
Dim: 18x5x1
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures: A

Edge Angle: medium

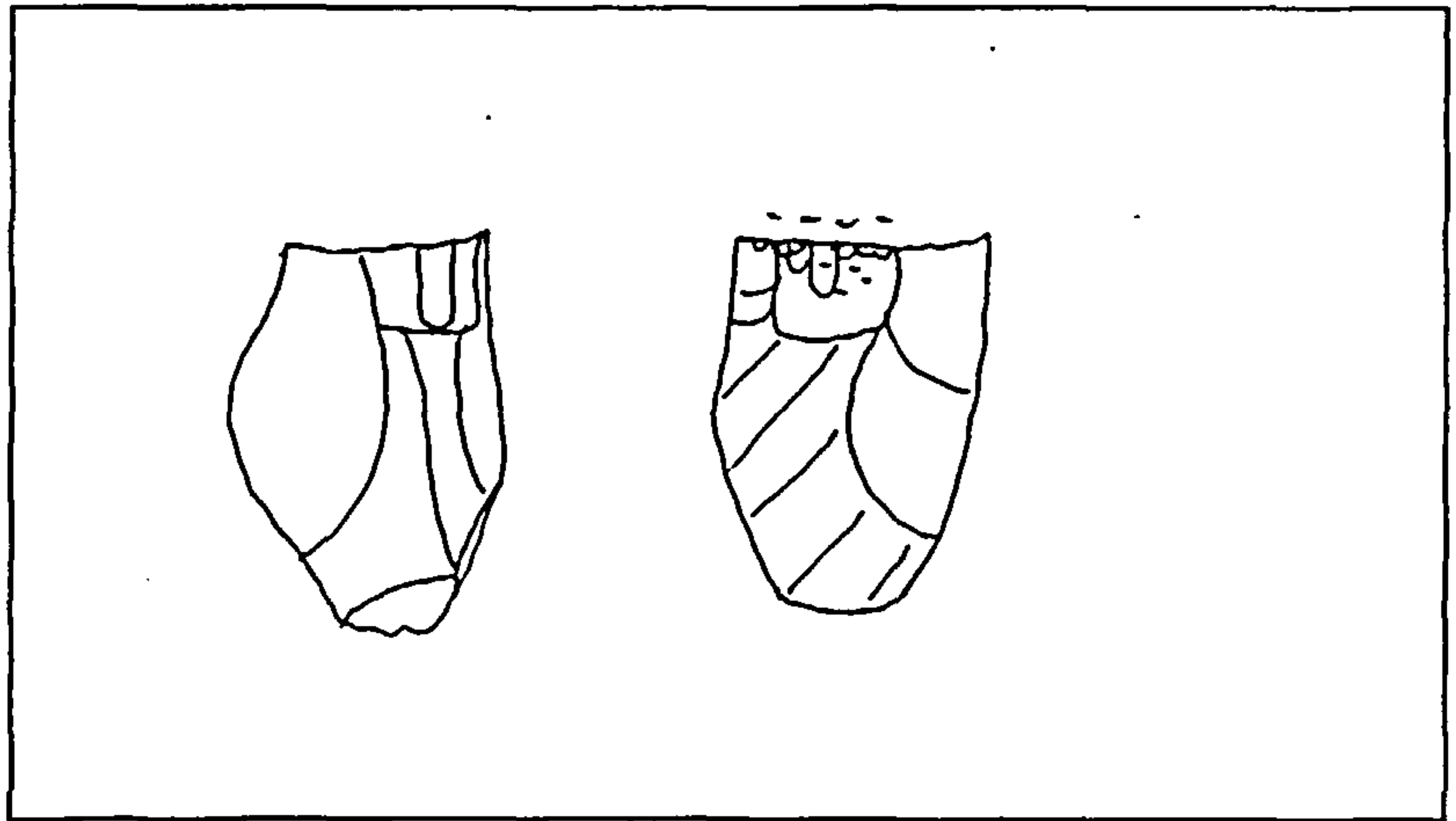
Traces:

Dorsal side b: occasional clustered medium feather terminating deep scars, associated with A: restricted patchy polish away from edge. Polish is smooth domed, partially linked, developed, with abrupt edges and common minute irregular pits. Also B: restricted patchy (linear) polish along edge. Polish is smooth domed, partially linked, with gradual edges and occasional medium pits. Polish in retouch on edge, but does not continue onto ventral at all.

Ventral side b: occasional clustered, medium, feather terminating deep scars. No polish.

Interpretation: side b used, pos transverse
Comments:

Ref: S1856
Type:
Blank: FLAKE
Mat: FLINT
Dim: 30x27x16
Qual: MED
Cond: SW



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: thick

Traces:

edge damage impossible to record due to battering by
preparation

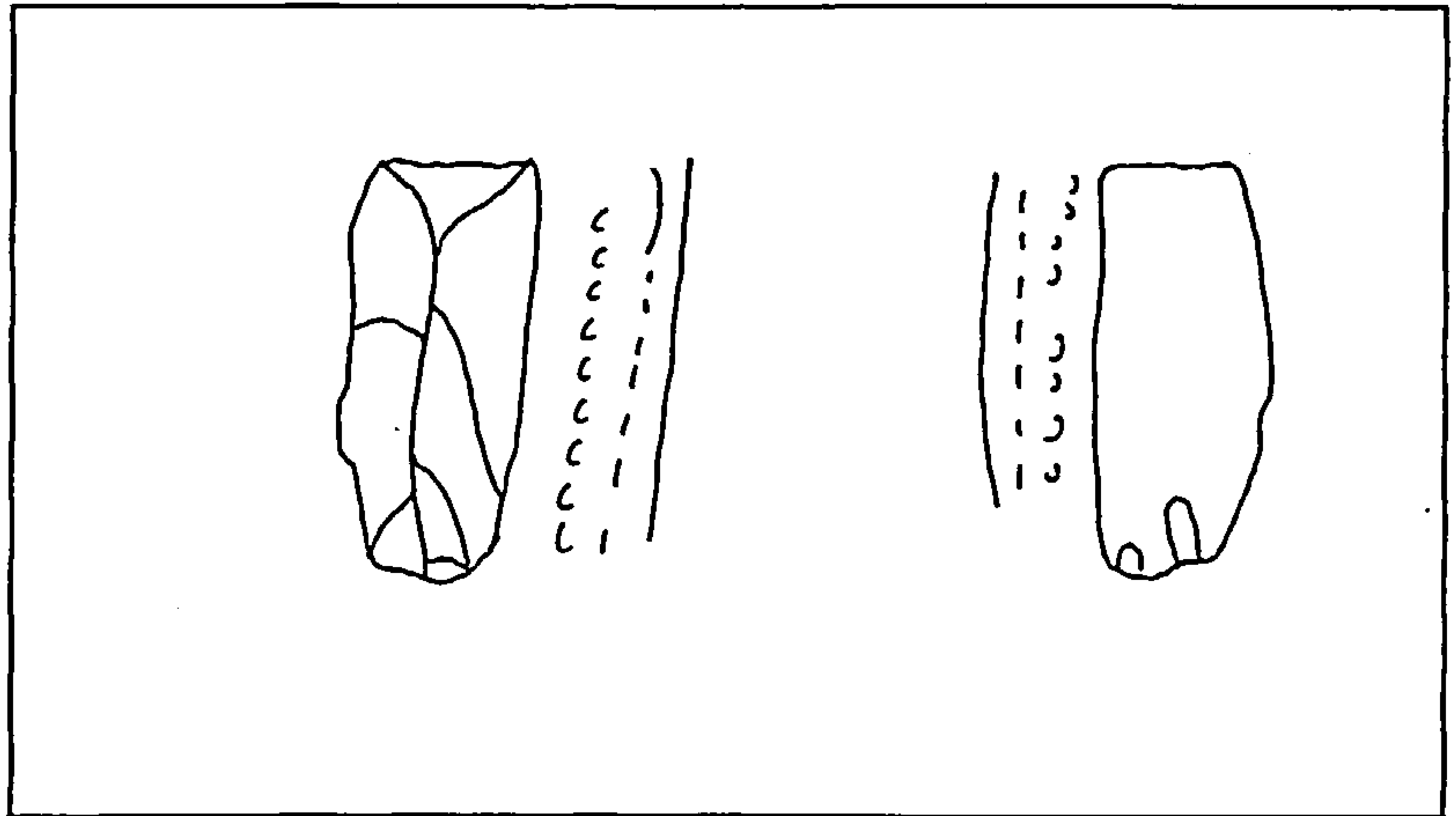
Polish A: broad spread on edge. Polish is smooth
invasive, partially linked, with gradual edges and
occasional small circular pits.

Polish B: restricted patches away from edge. Polish
is smooth domed, allover, developed, bright, with
gradual edges and occasional small circular pits.

Interpretation: platform pos used. transverse use

Comments: problems caused by both techno features from
use as core, but also from weathering effects

Ref: S1872
Type: ED
Blank:
Mat: FLINT
Dim:
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures: A

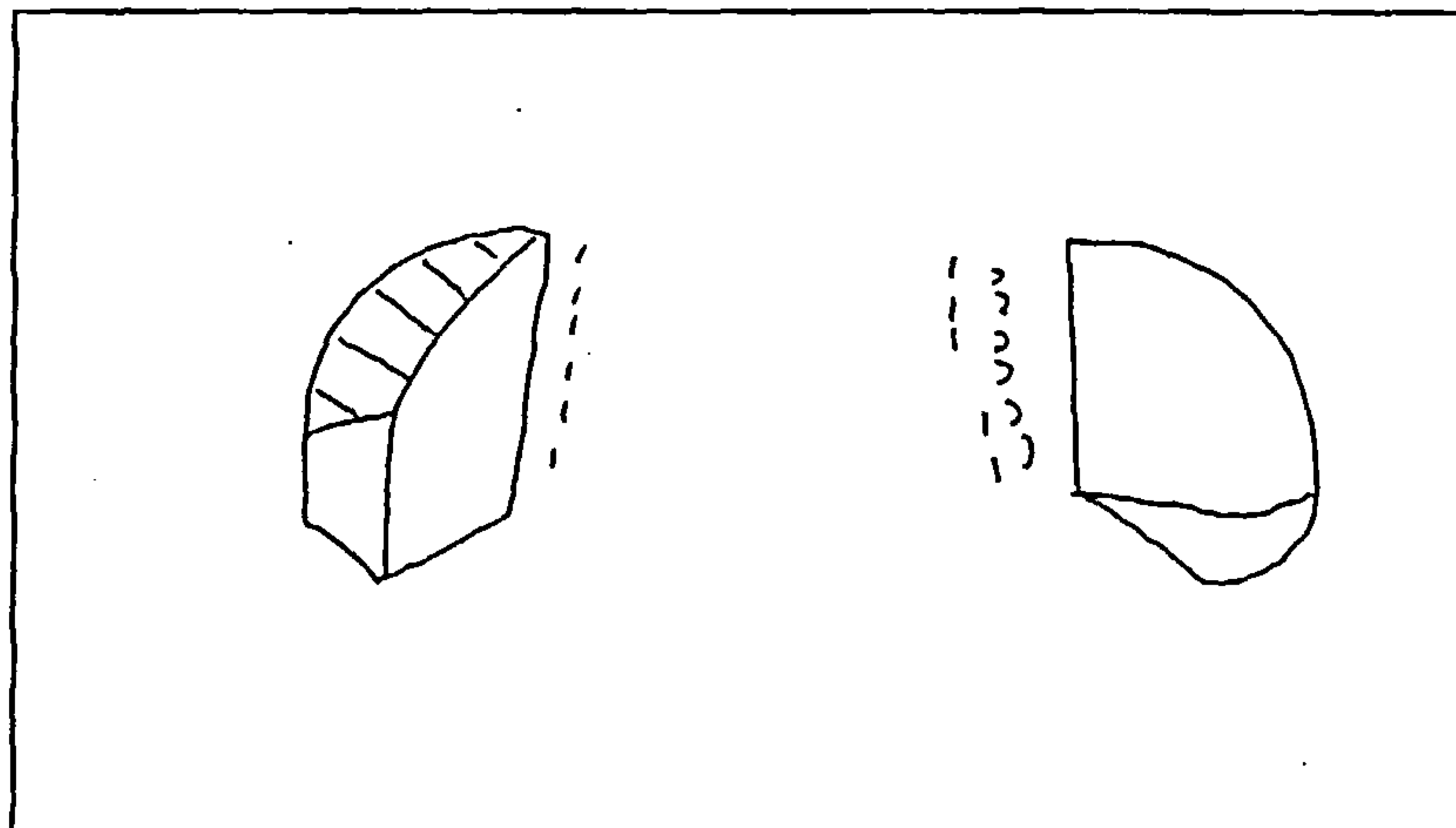
Edge Angle: medium

Traces:

Side b, most features the same on both sides: numerous clustered and layered small to minute mostly step terminating mixed scars, associated with A: restricted patchy polish. Polish is smooth flat to domed, allover, developed, bright, with sharp edges and rare small circular pits. Associated are numerous random striations. Also B: patchy polish along and away from edge. Polish is smooth flat reticulated, partially linked, developed, variable, with gradual edges and occasional small circular pits. Associated are frequent random striations. Also C: patchy spread along edge. Polish is smooth flat reticulated, scattered, variable with gradual edges and no internal features. Also D: Patchy narrow linear polish along edge. Polish is smooth domed (invasive), allover, developed, with sharp edges and common small circular pits. Associated are perpendicular short deep fine striations. Also with E: restricted, patchy polish along extreme edge. Polish is smooth invasive, allover, developed, bright, with gradual edges, and occasional variable irregular pits.

Interpretation: side b used, probably long motion
Comments: striations very confusing

Ref: S1873
Type:
Blank: BLADE
Mat: FLINT
Dim: 24x12x5
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: medium

Traces:

See S1872 for polishes

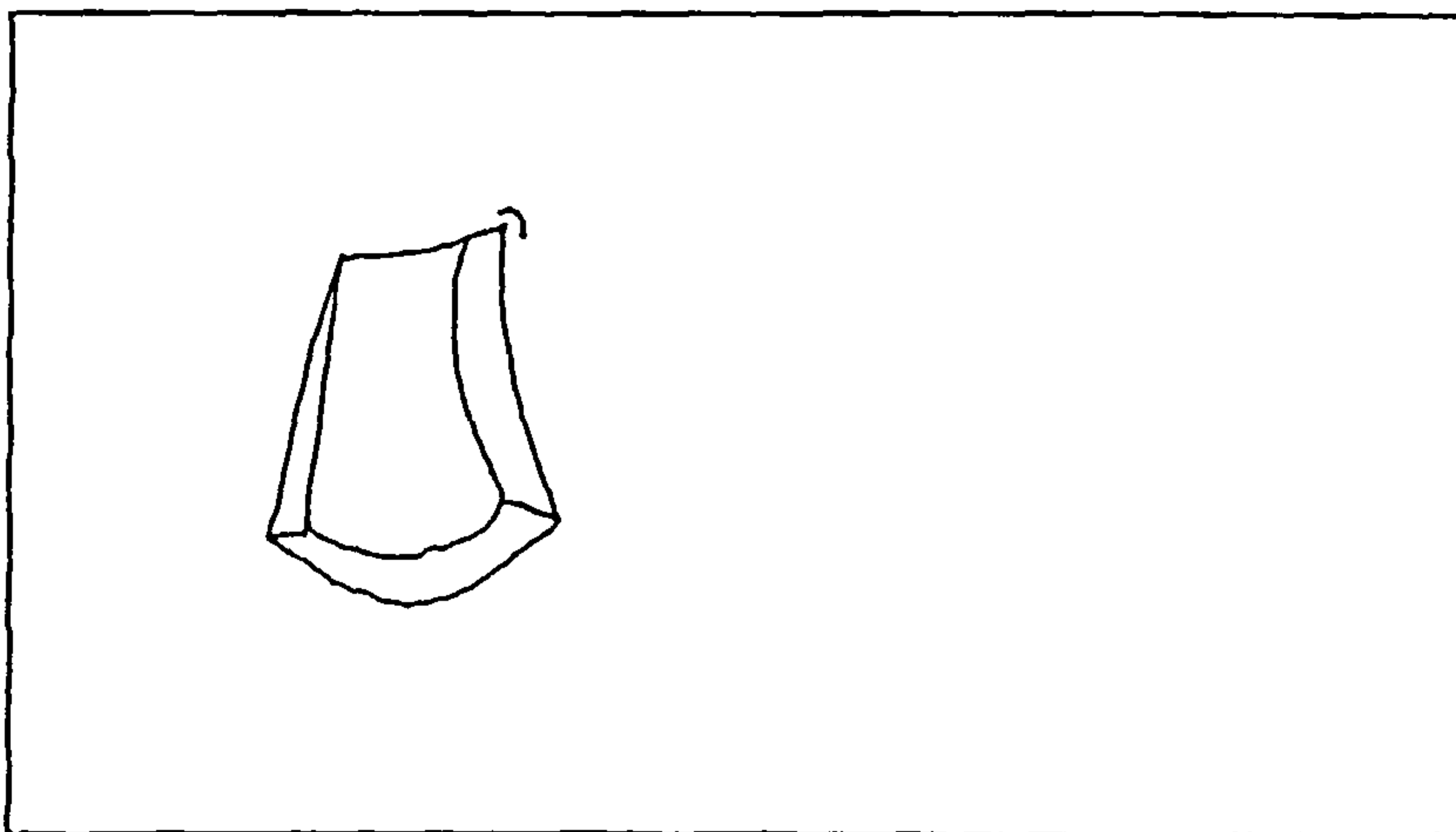
Ventral side b: frequent clustered and layered
medium to small mostly step terminating mixed scars.
Associated with polish C and E

Dorsal side b: polish D and F: patchy spread on and
away from edge. Polish is smooth domed, scattered
with sharp edges and occasional small circular pits.

Interpretation: side b used, prob long motion

Comments: traces continue from piece S1872, but dominant
side twisted over - piece broken due to subsequent stress
build up.

Ref: S1875
Type: CORE
Blank: CORE
Mat: CHERT
Dim: 15x26x34
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: thick

Traces:

Edge damage impossible to record due to techno
damage.

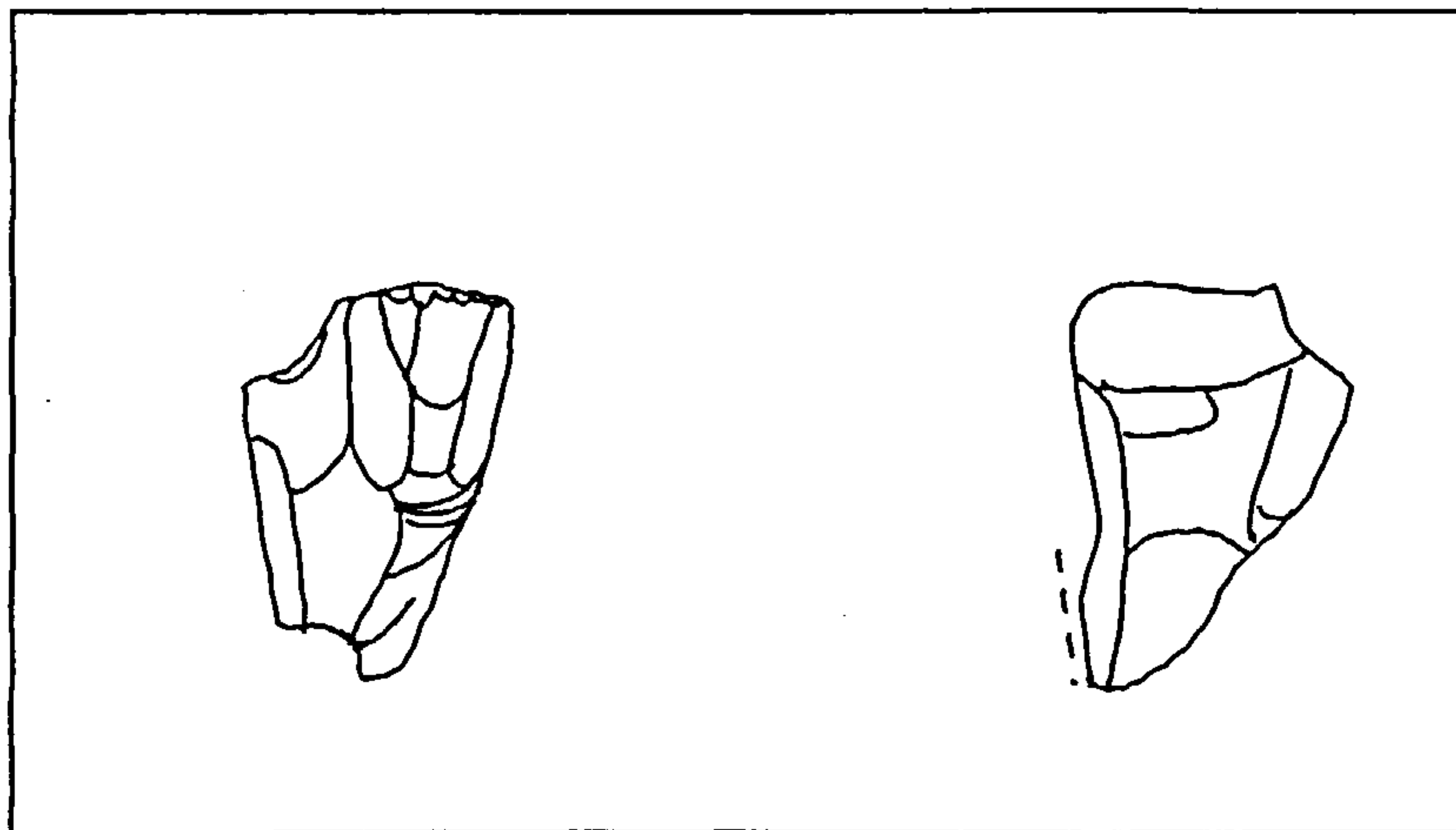
Polish A: restricted patchy polish away from edge.
Polish is smooth invasive, allover, developed, with
gradual edges and common medium circular pits.

Polish B: resrticted patchy polish away from edge.
Polish is smooth domed, partially linked, developed,
bright, with soft edges and occasional small
circular pits. B fades into A.

Interpretation: Projecting corner used. Possibly as
"hammer" on a medium soft material

Comments: Obvious problems in interpreting traces on a
core as the use of that core as a hammer. However, traces
on a projecting corner, rather than on a platform, also
no similar traces observed on numerous other experimental
and prehistoric cores.

Ref: S1877
Type: CORE
Blank: CORE
Mat: CHERT
Dim: 26x22x15
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A

Edge Angle: acute

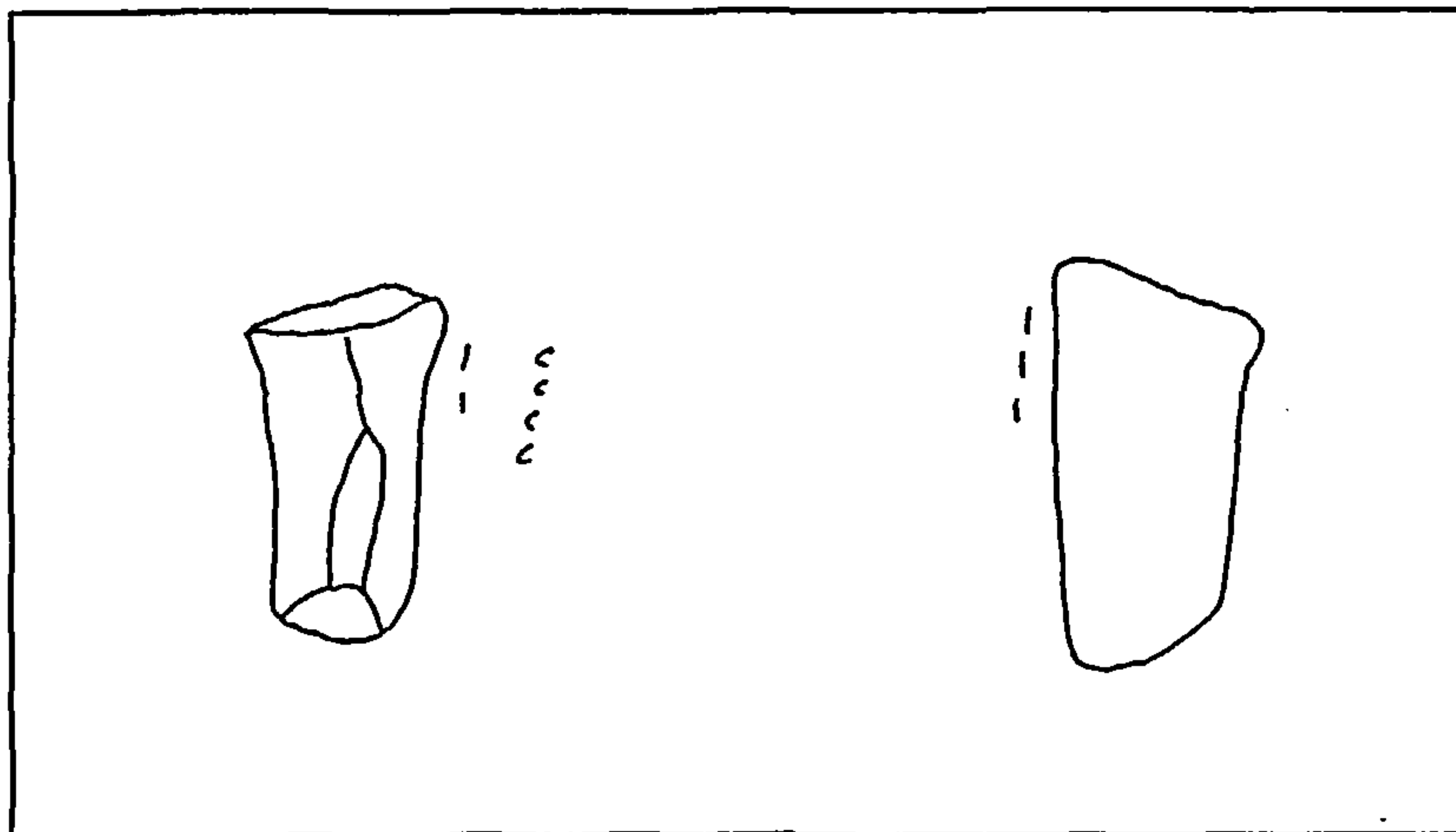
Traces:

No associated edge damage. Patchy polish on edge.
Polish is smooth reticulated partially linked, with
sharp edges and occasional small circular pits

Interpretation: side used, soft material

Comments: opp use of a sharp edge

Ref: S1879
Type:
Blank: FLAKE
Mat: CHERT
Dim: 21x14x3
Qual: GOOD
Cond: FRESH



Material: Grain: M Homog: V Crys: C Topo: R Fissures:
F

Edge Angle: medium

Traces:

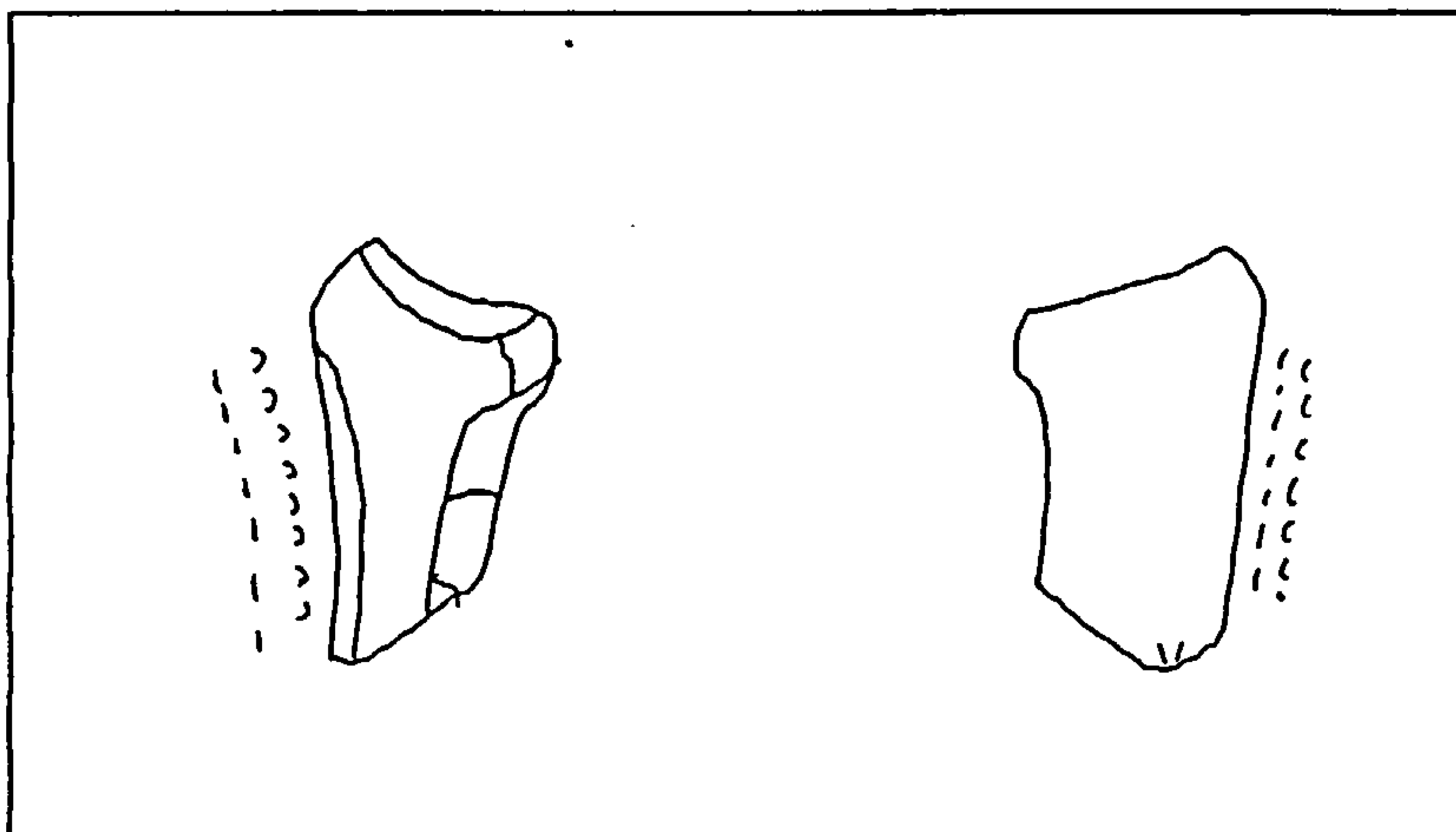
Dorsal side b: common clustered and layered medium step terminating deep scars, associated with restricted patchy polish on edge. Polish is smooth domed, partially linked, developed, bright, with gradual edges and no internal features. Also with patchy restricted polish on edge. Polish is smooth domed, allover, developed, with gradual edges and common small circular pits. Associated with random striations.

Ventral side b: no edge damage. Patchy polish on and away from edge. Polish is smooth reticulated, scattered, with gradual edges and no internal features.

Interpretation: side b used. Transverse motion, prob hard material

Comments:

Ref: S1880
Type:
Blank: FLAKE
Mat: CHERT
Dim: 25x16x4
Qual: GOOD
Cond: FRESH



Material: Grain: M Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: thick

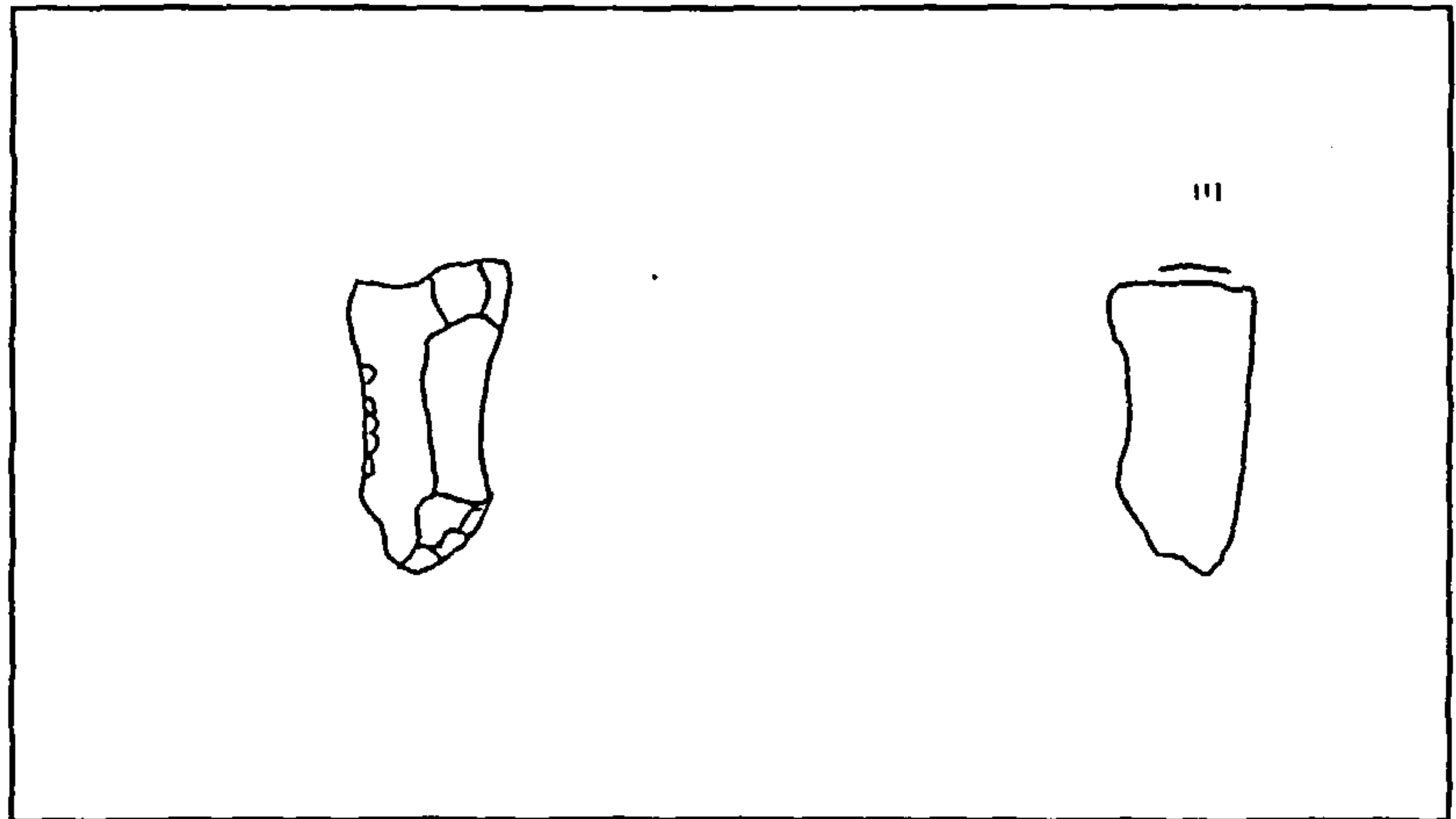
Traces:

Dorsal side a: frequent clustered small step terminating deep scars, associated with patchy polish on edge. Polish is smooth invasive, partially linked, variable, with gradual edges and common minute circular pits.

Ventral side a: common clustered small step terminating deep scars, associated with patchy polish on edge. Polish is smooth invasive, partially linked, with gradual edges and common medium irregular pits.

Interpretation: side a used. Transverse motion
Comments: section makes long motion unlikely

Ref: S1896
Type: ED
Blank: BLADE
Mat: FLINT
Dim: 27x15x4
Qual: MED
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
O

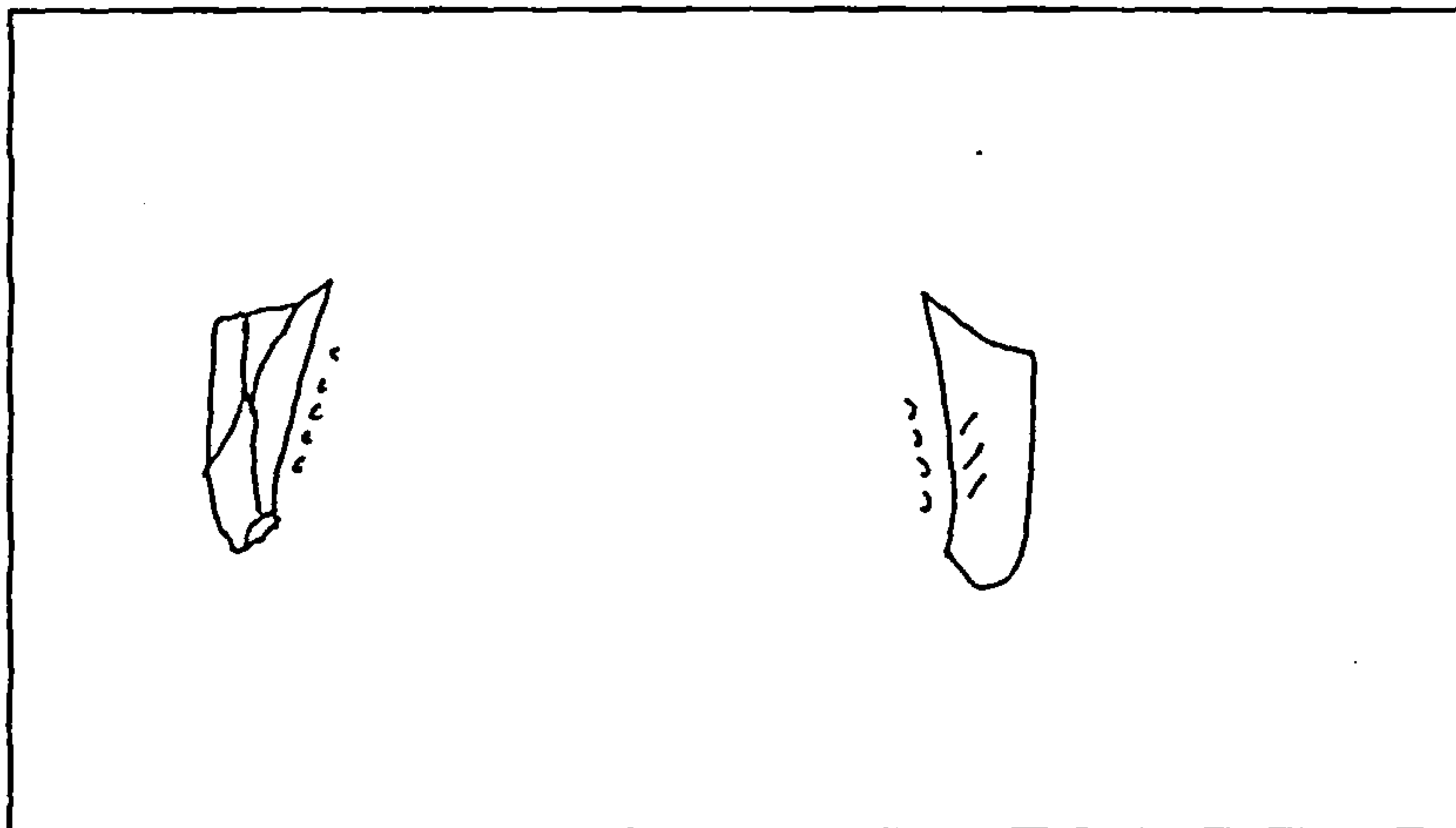
Edge Angle: medium

Traces:

Ventral distal end: no edge damage, restricted narrow linear polish along edge. Polish is smooth flat, allover, intense, bright, with abrupt edges and rare minute circular pits. Associated with perpendicular short deep narrow numerous striations.

Interpretation: distal end used, transverse motion
Comments:

Ref: S1897
Type:
Blank: BLADE
Mat: CHERT
Dim: 20x10x2
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: medium

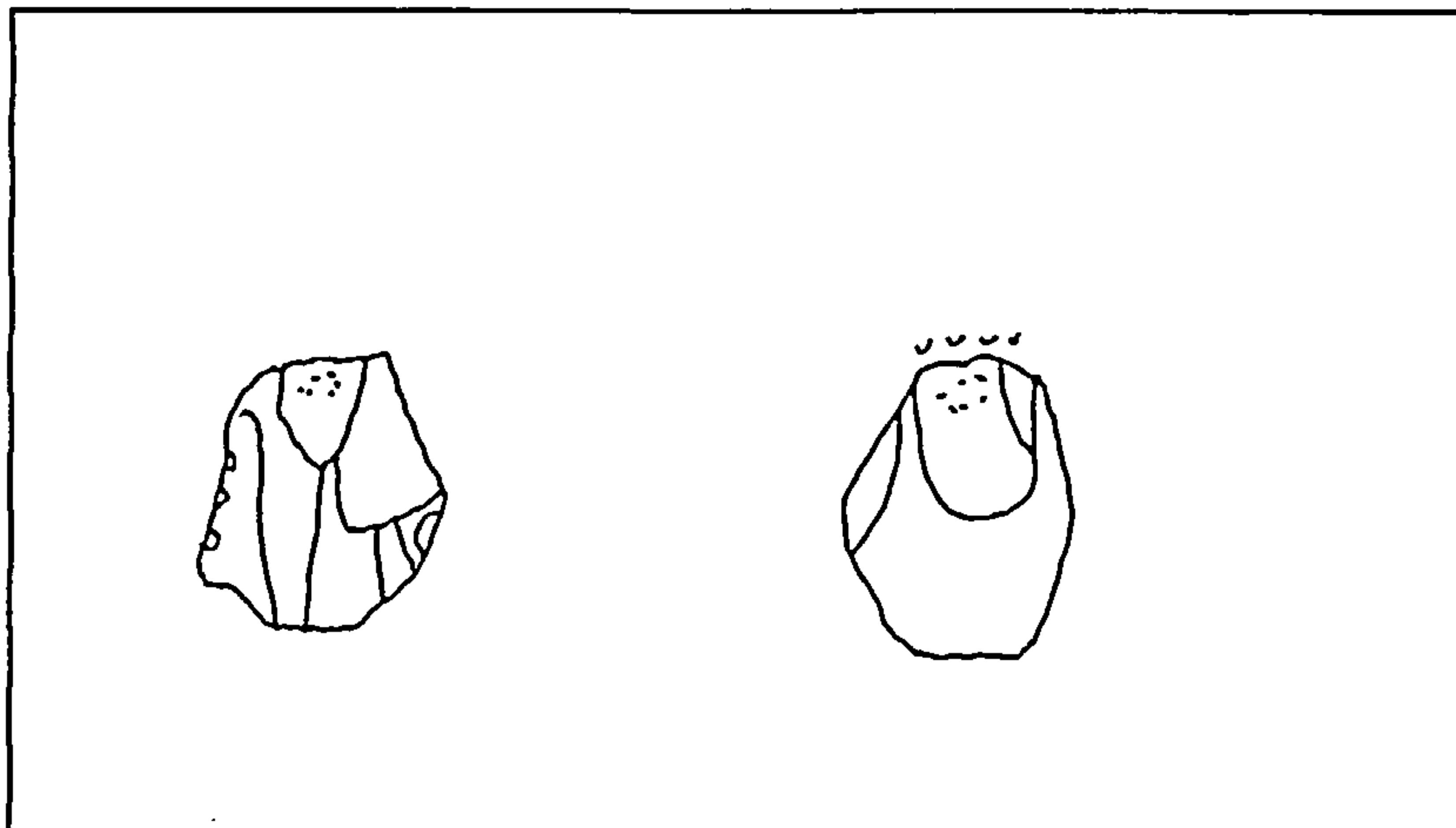
Traces:

Side b, both faces: occasional scattered deep mostly
feather terminating small scars.

Ventral face: Restricted linear polish away from
edge and on interior face 75o to perpendicular to
edge. Polish is rough reticulated, scattered,
developed, with sharp edges and no internal
features.

Interpretation: Used
Comments:

Ref: S1899
Type:
Blank: FLAKE
Mat: CHERT
Dim: 28x25x18
Qual: MED
Cond: FRESH



Material: Grain: M Homog: V Crys: C Topo: F Fissures:
0

Edge Angle: thick

Traces:

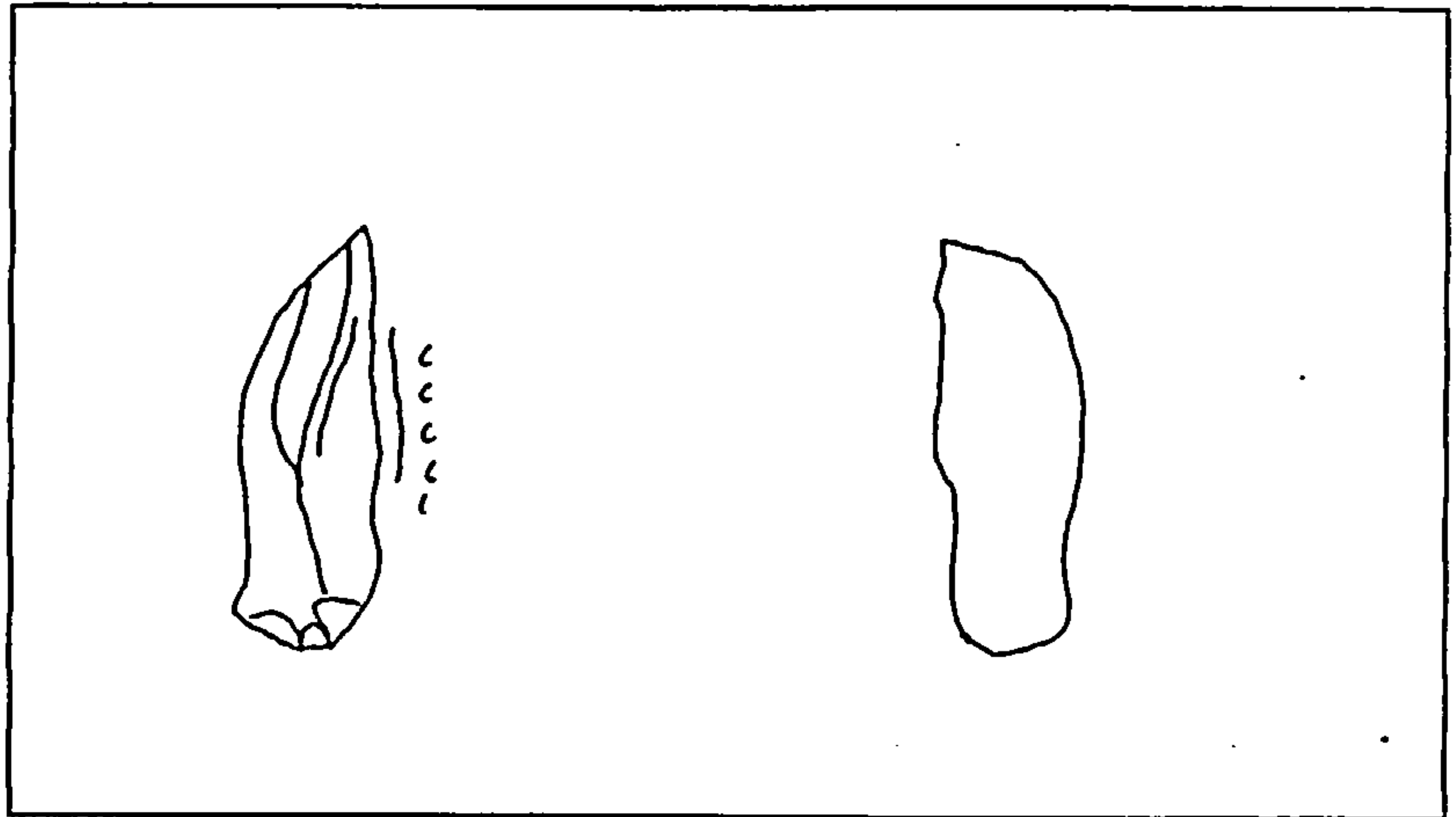
Distal end, dorsal face: No edge damage. Patchy polish away from edge. Polish is smooth flat, allover, developed, with abrupt edges and occasional minute circular pits.

Distal end, ventral face: numerous clustered large to medium mostly feather terminating deep scars associated with patchy polish away from edge. Polish is smooth flat, allover, developed, with abrupt edges and occasional minute circular pits.

Interpretation: distal end used, probably transverse motion

Comments:

Ref: S1900
Type:
Blank: BLADE
Mat: FLINT
Dim: 37x14x3
Qual: GOOD
Cond: BURNT



ü

Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A

Edge Angle: medium

Traces:

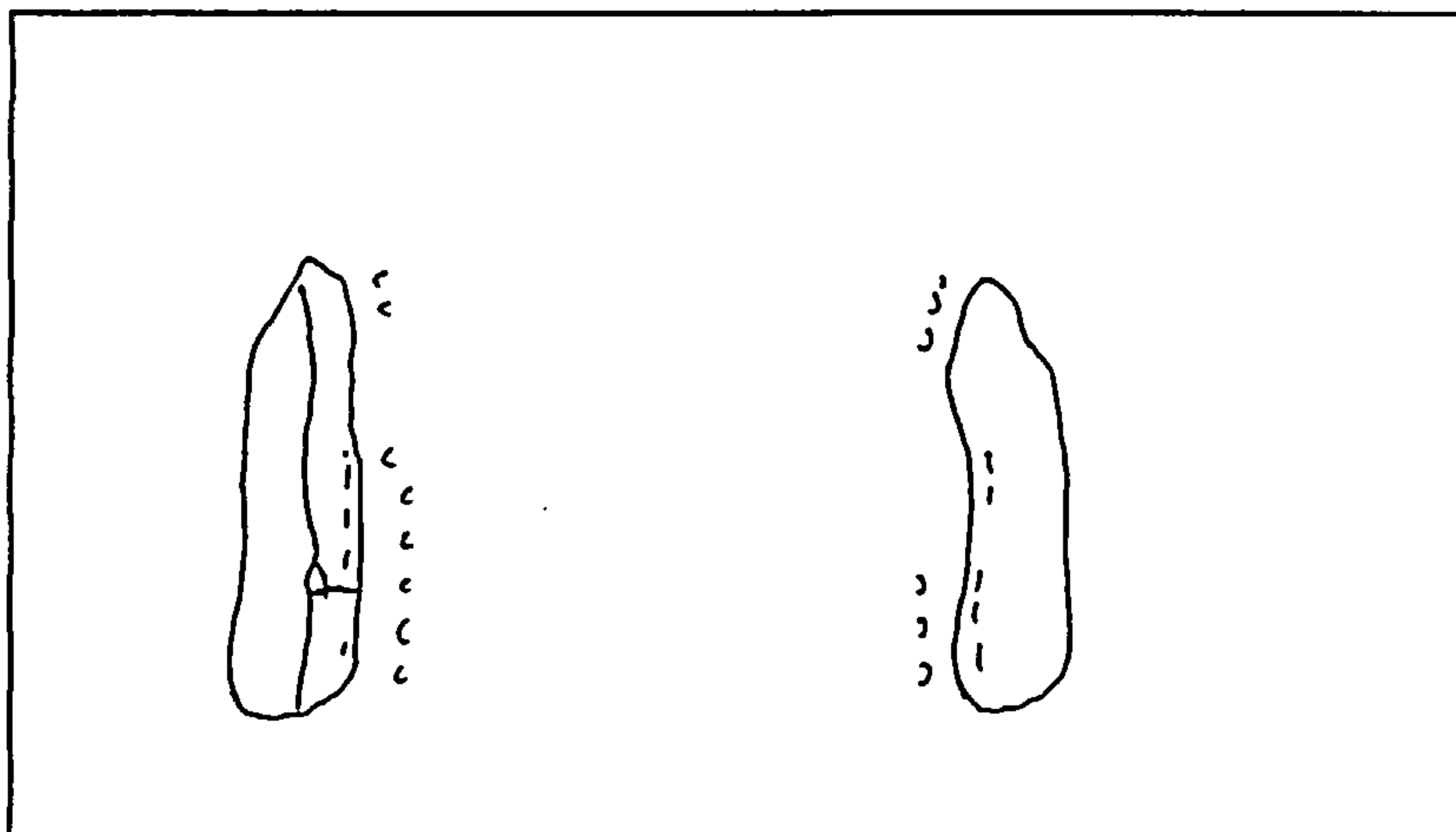
Dorsal side b: common clustered medium feather
terminating deep scars, associated with a restricted
linear polish along edge. Polish is smooth flat,
allover, with sharp edges and no internal features.

Dorsal ridge: The same polish as on side b runs
along the dorsal ridge

Interpretation: prob used

Comments: difficult to assess because of burning

Ref: S1901
Type:
Blank: BLADE
Mat: FLINT
Dim: 36x12x4
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A

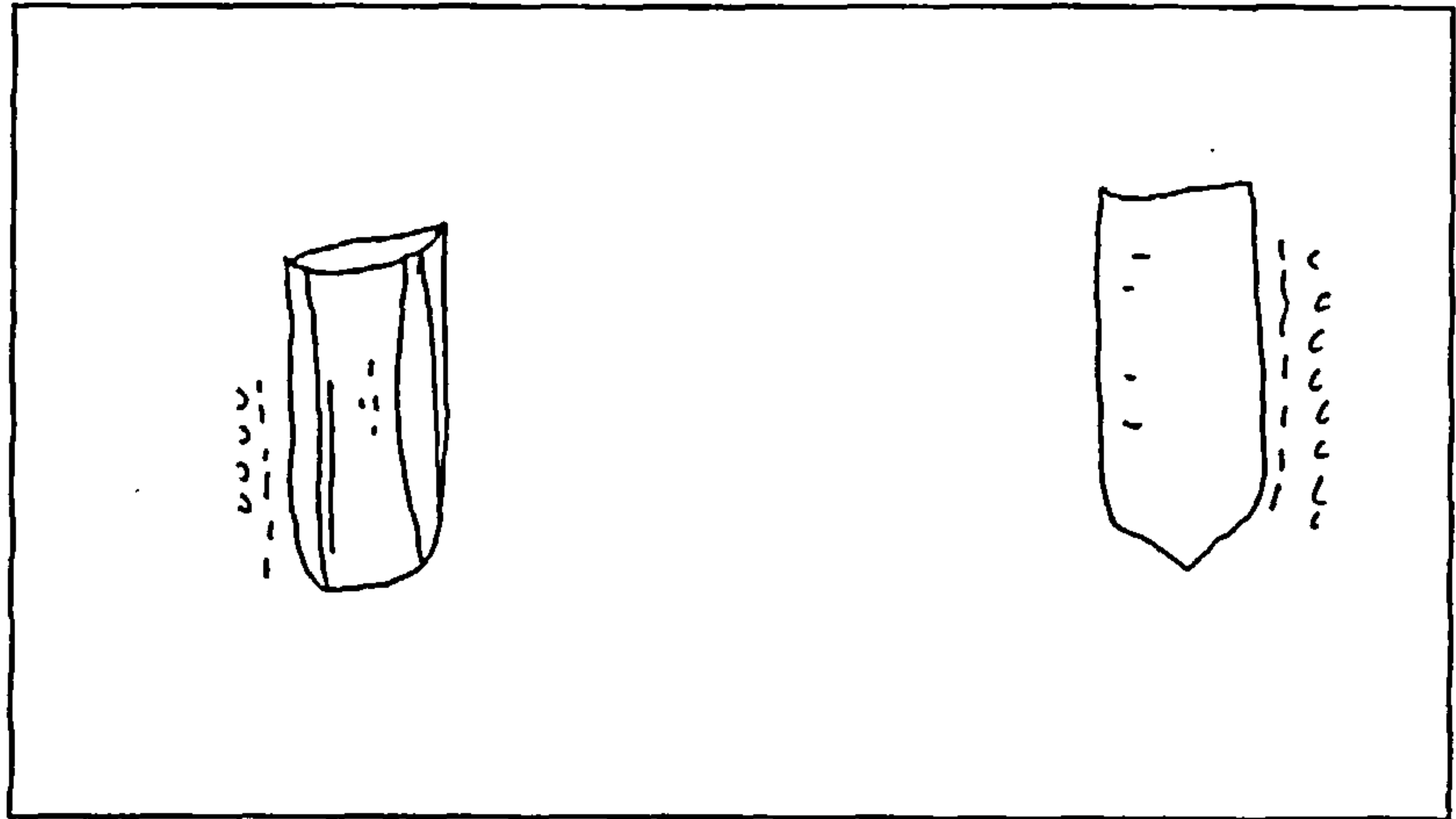
Edge Angle: medium

Traces:

Side b, both faces: occasional clustered small mostly feather terminating deep scars associated with patchy narrow linear polish away from edge. Polish is smooth flat, allover, intense, bright, with sharp edges and no internal features.

Interpretation: side b used. Long motion. Soft material
Comments:

Ref: S1912
Type:
Blank: BLADE
Mat: FLINT
Dim: 27x12x5
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: medium

Traces:

Dorsal side a: occasional clustered medium to small mostly feather terminating mostly shallow scars associated with restricted patchy polish along edge. Polish is smooth flat, partially linked, variable with gradual edges and common medium irregular pits.

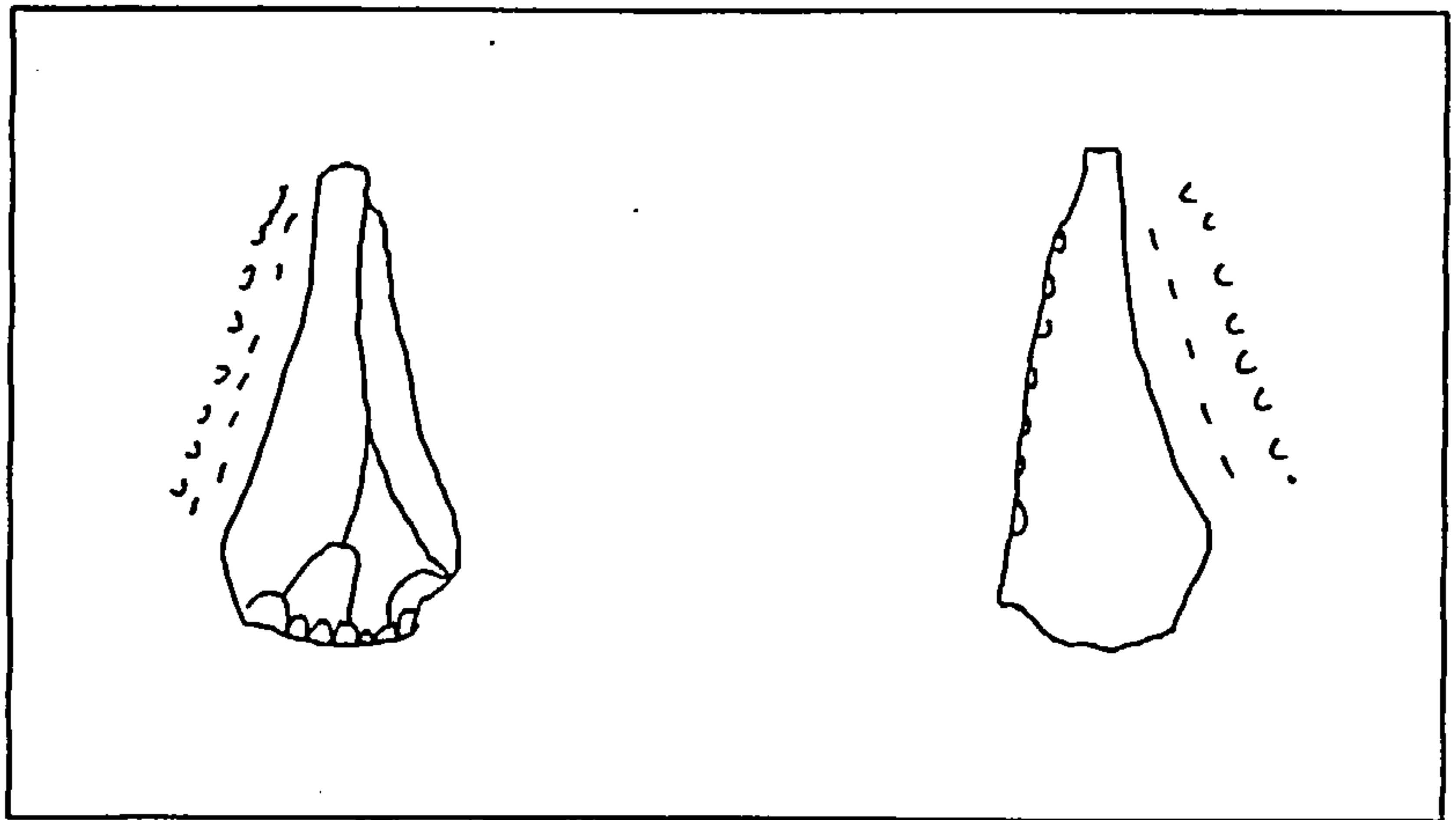
Ventral side a: common clustered and layered medium to small feather terminating shallow scars associated with polish as on dorsal and restricted patchy polish on edge. Polish is smooth flat, allover, developed, bright, with sharp edges and common small irregular pits.

Dorsal ridge: restricted linear polish along ridge. Polish is smooth invasive, partially linked, widely variable with gradual edges and common medium irregular pits.

Both faces, interior: restricted patches. Polish is smooth flat allover, developed, bright, with sharp edges and common small irregular pits.

Interpretation: side a used. Deep penetration, soft material
Comments:

Ref: S1913
Type: ED
Blank: FLAKE
Mat: FLINT
Dim: 30x16x4
Qual: GOOD
Cond: PATINA



Material: Grain: F Homog: V Crys: O Topo: F Fissures:
A

Edge Angle: medium

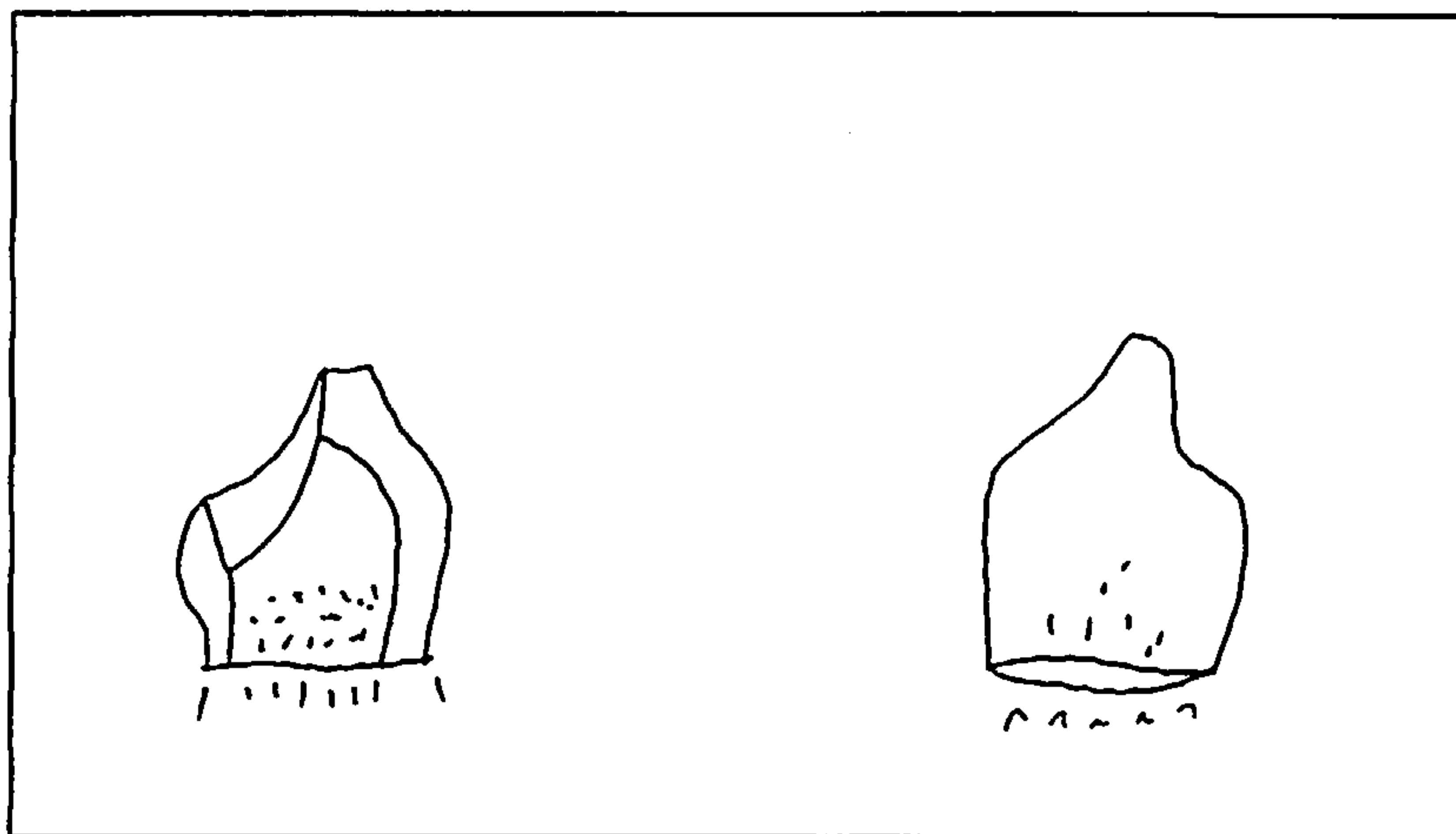
Traces:

Side a: common clustered medium to minute mostly step terminating mostly deep scars with snaps associated with patchy linear polish parallel to edge. Polish is smooth flat reticulated, partially linked, variable, with gradual edges and occasional minute circular pits.

Interpretation: side a used.

Comments: difficult as also clear NUW and techno features

Ref: S1915
Type:
Blank: FLAKE
Mat: FLINT
Dim: 12x13x2
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures: A

Edge Angle: acute

Traces:

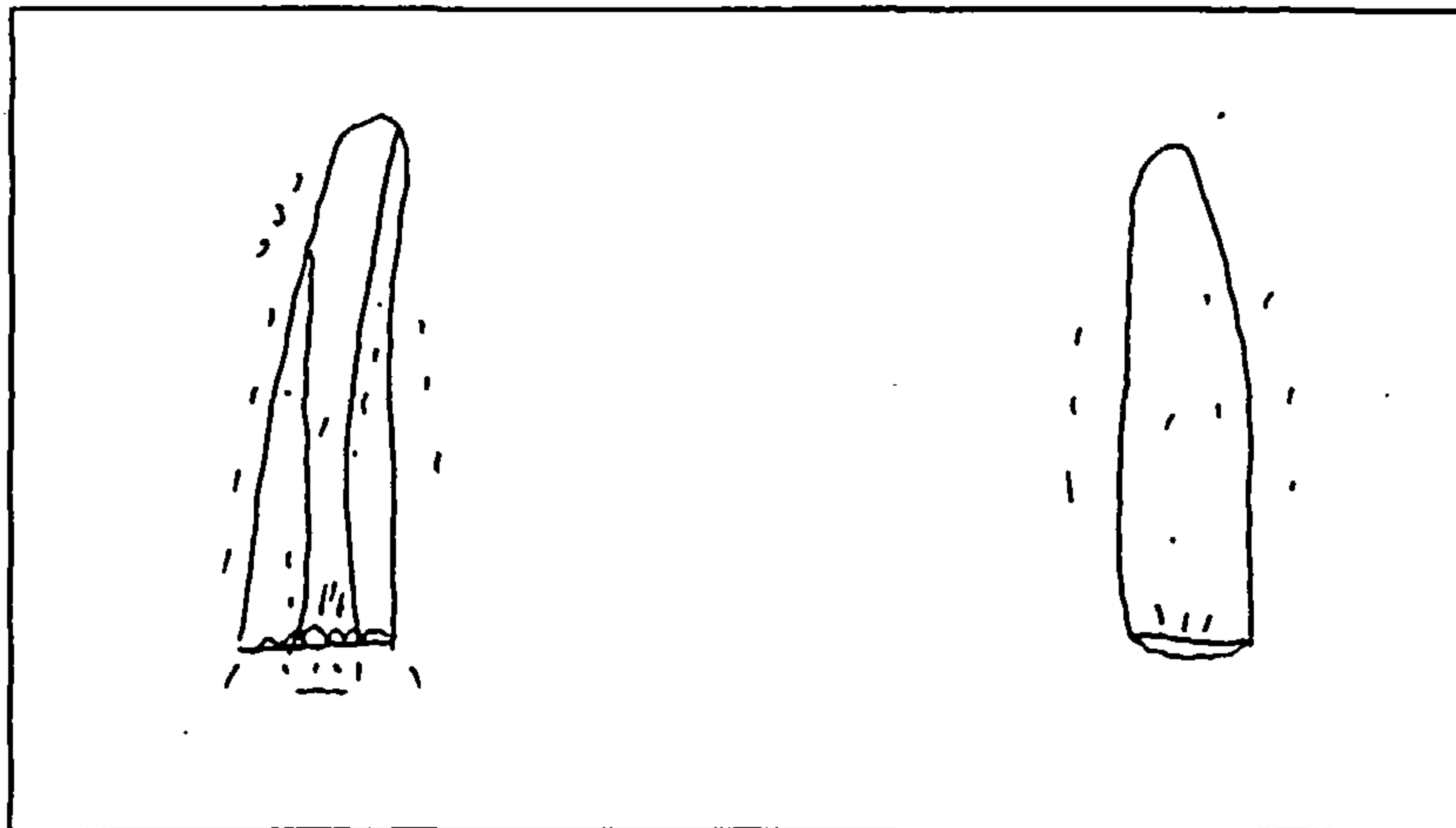
Dorsal proximal end: no edge damage. Broad spread of polish on interior face. Polish is smooth flat allover, intense, bright, with gradual edges and common small irregular pits. Associated with perpendicular long shallow broad frequent striations.

Ventral proximal end: occasional clustered medium mostly step terminating deep scars associated with patchy linear polish away from edge. Polish is smooth flat reticulated, scattered, developed, bright, with sharp edges and common small irregular pits

Interpretation: proximal end used, heavy use

Comments: part used is a break edge - this is a blade end segment

Ref: S1916
Type:
Blank: BLADE
Mat: FLINT
Dim:
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A

Edge Angle: acute

Traces:

very similar to piece S1915

Both sides: occasional clustered medium mixed
termination deep scars.

Both sides and interior faces: restricted patchy
polish away from edges and on interior faces. Polish
is smooth flat reticulated, partially linked,
developed, bright, with sharp edges and occasional
medium irregular pits.

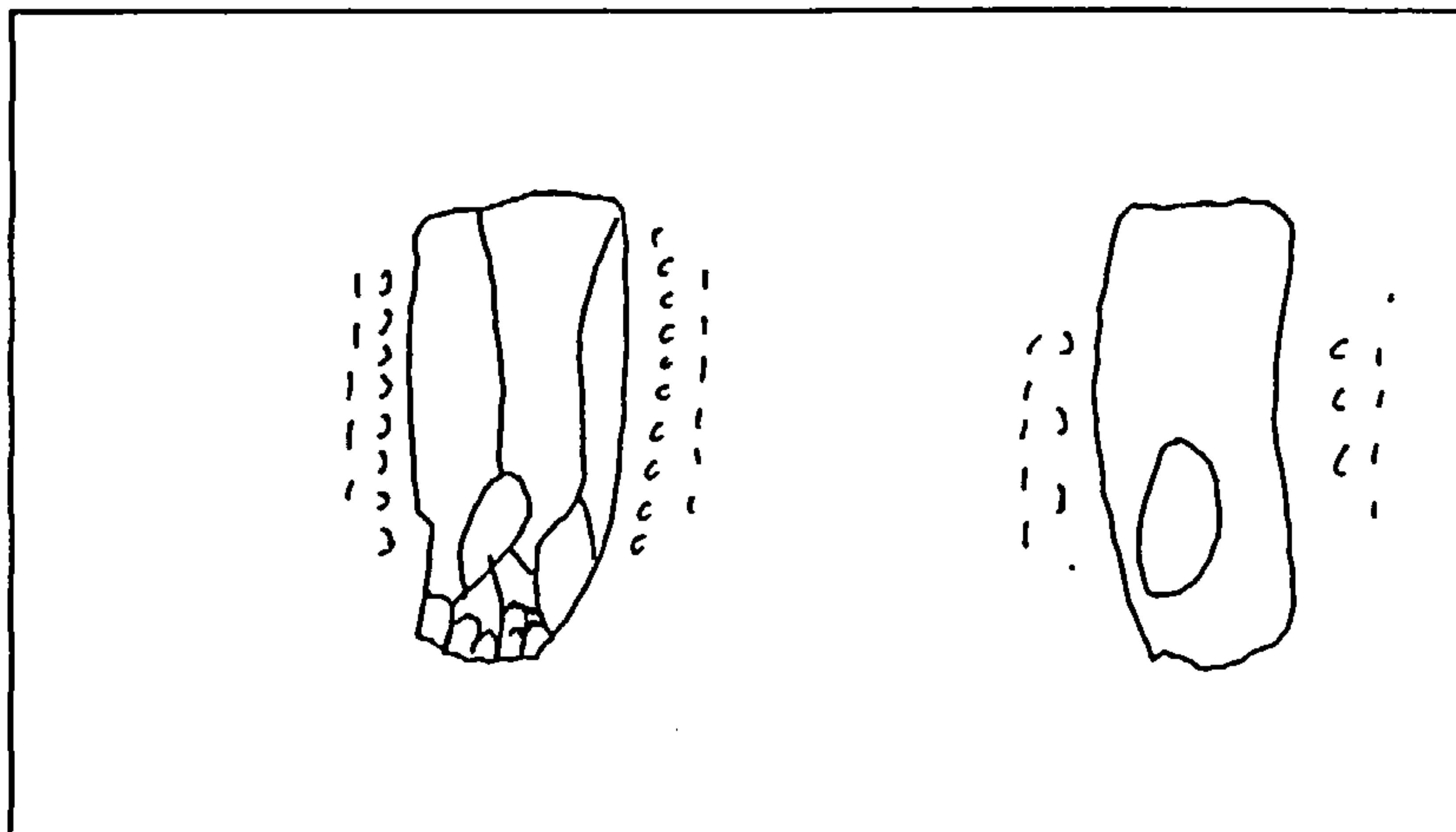
Dorsal proximal end: Restricted patchy polish on and
away from edge. Polish is smooth flat, all over,
developed, bright, with gradual edges and occasional
medium circular pits. Associated with perpendicular
medium deep fine striations.

Ventral proximal: As dorsal proximal plus restricted
linear (perpendicular) polish on interior. Polish is
smooth flat reticulated, scattered, developed,
bright, with abrupt edges and no internal features.

Interpretation: used

Comments: very hard to work out how

Ref: S1917
Type:
Blank: BLADE
Mat: FLINT
Dim: 36x16x6
Qual: GOOD
Cond: BURNT



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A

Edge Angle: medium

Traces:

Both sides are the same, with side a more developed and frequent.

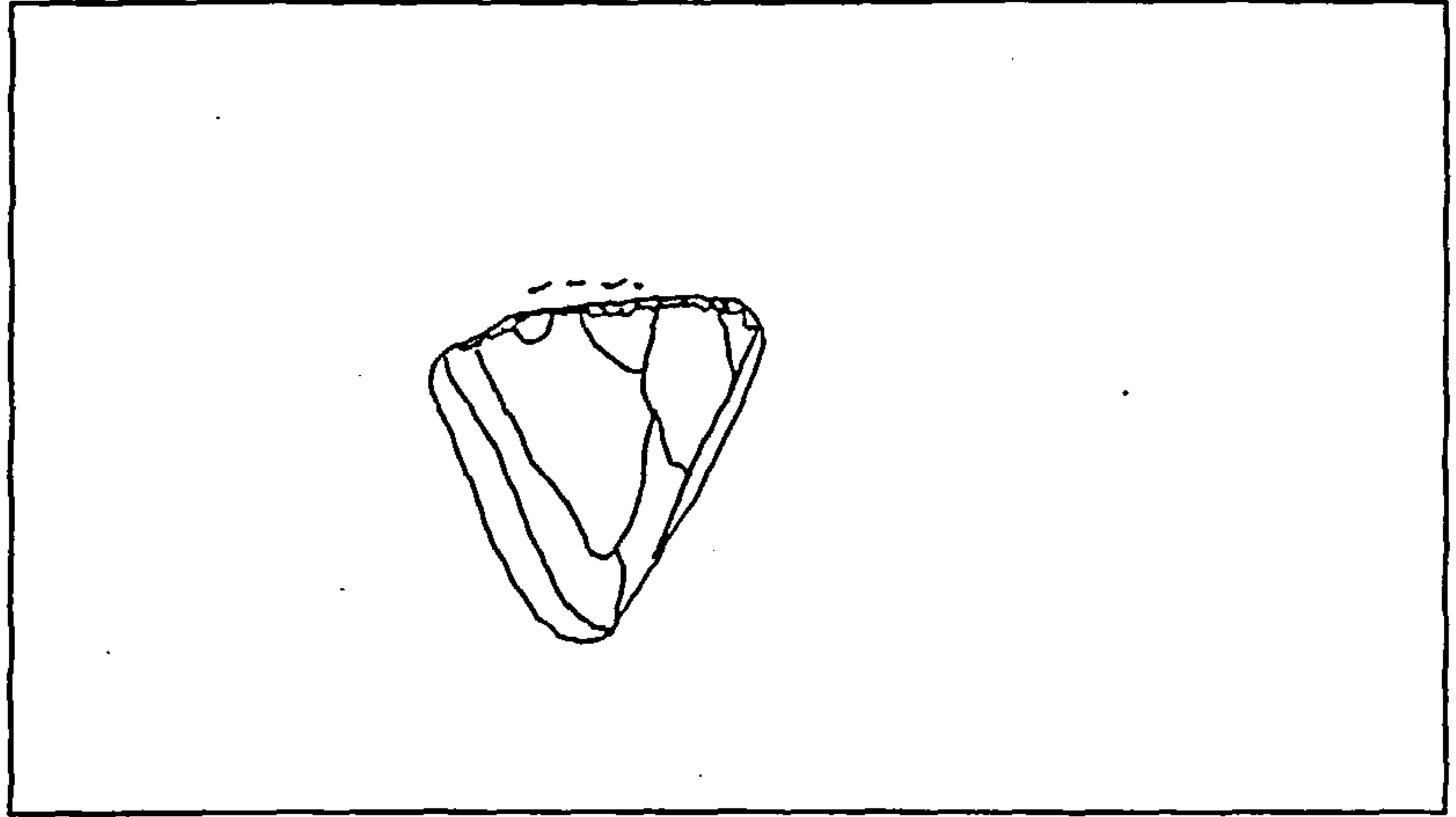
Dorsal: frequent clustered medium to small feather terminating deep scars associated with restricted patchy linear polish along edge and around scar ridges. Polish is smooth invasive, partially linked, with soft edges and common small circular pits. Also with patchy polish away from edge. Polish is smooth flat, allover, developed, bright, with sharp edges and common medium irregular pits.

Ventral: Occasional clustered medium to small feather terminating deep scars associated with patchy polish on edge. Polish is smooth reticulated, scattered, poor, with gradual edges and common small irregular pits.

Interpretation: used, both sides

Comments: appears to be the same function twice, side a used more heavily. Mostly unifacial distribution, but best polish and edge damage on the same face.

Ref: S1918
Type: CORE
Blank: CORE
Mat: FLINT
Dim: 25x24x22
Qual: EXC
Cond: BURNT



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A

Edge Angle: thick

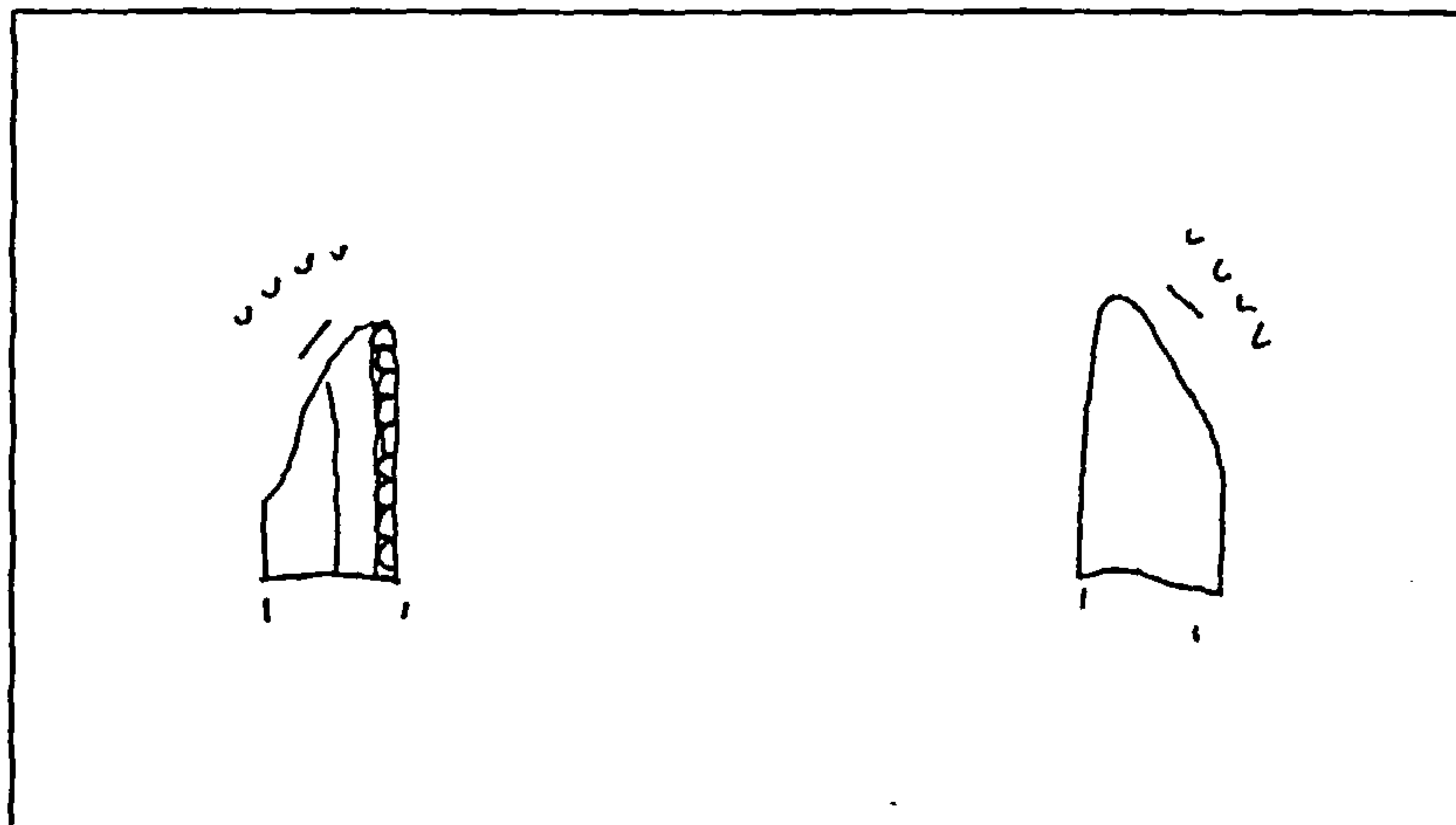
Traces:

edge damage not recorded due to extensive platform
preparation

Polish; patchy on edges. Polish is smooth invasive,
partially linked, variable, with gradual edges and
common small irregular pits

Interpretation: used, transverse
Comments: as scraper

Ref: S1988
Type: MICRO
Blank: BLADE
Mat: CHERT
Dim: 11x5x2
Qual: MED
Cond: FRESH



Material: Grain: M Homog: V Crys: F Topo: F Fissures:
0

Edge Angle: acute

Traces:

Side a, both sides very similar: occasional to common clustered medium to small mostly feather terminating deep scars, associated with patchy spread of polish along and away from edge. Polish is rough reticulated, partially linked, with gradual edges and no internal features.

Interpretation: side a used, opp use, long motion

Comments: crystals make this piece difficult,
interpretation represents a minimum use.

Starr: Sample with wear traces

N	TYPE	MOTION	HARD	MAT	FUNCTION	NOTES
----	-----	-----	-----	----	-----	-----
1	USED	LONG	SOFT		CUT	
11	USED	TRANSVE	SOFT			
14	USED	TRANSVE	HARD			
26	USED	TRANSVE	MED S	WOOD?	SHAVE	
48	USED	TRANSVE	HARD		SHAVE	
49	USED	TRANSVE	MED H		SHAVE	
50	USED	BIDIR	MED H		SAW	
51	USED	LONG	SOFT			
52	USED	TRANSVE	MED S			
55	USED	LONG	MED S		CUT	2 SIDES
56	USED	TRANSVE	MED	WOOD	SHAVE	INTENSE
85	USED	TRANSVE	HARD			SHORT USE
88	USED	TRANSVE	MED	WOOD?	SCRAPE	DIFFICULT
151	USED	TRANSVE	HARD		SHAVE	DIFFICULT
155	USED	BIDIR	MED H		SAW	
156	USED	LONG	HARD			
157	USED	TRANSVE	MED H		SHAVE	
159	USED	LONG	MED H			
162	USED	TRANSVE	MED			
163	USED	TRANSVE	MED H	WOOD?	SHAVE	2 SIDES
165	USED	LONG	MED H		GROOVE	
167	USED	LONG				OPP TO RET
169	USED	TRANSVE	SOFT			
170	USED	TRANSVE	MED H			
171	USED	BIDIR	MED		SAW	
196	USED	LONG	MED			
212	USED	LONG	MED		GROOVE?	DIFFICULT
254	USED	TRANSVE	SOFT	PLANT		INTENSE
270	USED	TRANSVE	MED H		PLANE	
291	USED	LONG	MED S			
347	USED	TRANSVE	MED S		SCRAPE	
349	USED	BIDIR	HARD		SAW	
350	USED	BIDIR	HARD		SAW	
353	USED	BIDIR	HARD		SAW	
355	USED	?	SOFT			
360	USED	TRANSVE	MED S			
361	USED	BIDIR	MED		SAW	
366	USED	?	MED H		COMPLEX	DIFFICULT
367	USED	LONG	MED H			DIFFICULT
368	USED	BIDIR	MED S		SAW	
371	USED	LONG	MED		CUT	
375	USED	TRANSVE				
379	USED	LONG	MED H	WOOD?		2 SIDES
381	USED	TRANSVE	MED		SCRAPE	INTENSE
399	USED	LONG	MED S		GROOVE	
505	USED	TRANSVE				
737	USED	LONG	?			LIGHT USE

N	TYPE	MOTION	HARD	MAT	FUNCTION	NOTES
----	-----	-----	-----	----	-----	-----
738	USED	LONG	MED S			
	DIFFICULT					
739	USED	TRANSVE	MED S		SHAVE	
747	USED	BIDIR	MED S		SAW	
748	USED	LONG	MED S			
750	USED	LONG	SOFT			DIFFICULT
752	USED	TRANSVE				DIFFICULT
754	USED	TRANSVE	SOFT			?
755	USED	PIERCE	MED S			
758	USED	LONG	MED S		GROOVE/CUT	
764	USED	LONG	SOFT?			
765	USED	BIDIR	MED H		SAW	
768	USED	BIDIR	MED S		SAW	INTENSE
773	USED	?				
774	USED	TRANSVE	MED		SCRAPE	INTENSE
777	USED	LONG	MED H			
778	USED	LONG	MED H			
779	USED	TRANSVE	MED	WOOD?	GOUGE?	CHISEL
786	USED	TRANSVE	MED		SCRAPE/PLANE	
787	USED	LONG	MED S			S
789	USED	LONG	HARD			INTENSE
791	USED	TRANSVE	MED S		SHAVE?	+ POINT?
793	USED	LONG	MED		CUT/SAW	INTENSE
794	USED	LONG	MED S			
835	USED	?	SOFT			DIFFICULT
856	USED	TRANSVE	MED		SCRAPE	DIFFICULT
872	USED	LONG	MED H			1/2 OF 873
873	USED	LONG	MED H			1/2 OF 872
875	USED	IMPACT	MED S		HAMMER	DIFFICULT
877	USED	LONG	MED H			DIFFICULT
879	USED	TRANSVE	HARD			
880	USED	TRANSVE	MED			
896	USED	LONG				
897	USED	LONG	MED S			
899	USED	TRANSVE	MED			DIFFICULT
900	USED	?				DIFFICULT
901	USED	LONG	MED		GROOVE?	
912	USED	LONG	SOFT		CUT DEEP	INTENSE
913	USED	LONG	MED H			DIFFICULT
915	USED	TRANSVE	MED H		COMPLEX?	
916	USED	LONG	MED H		COMPLEX?	
917	USED	LONG	MED S			2 SIDES
918	USED	TRANSVE	MED S		SCRAPE	DIFFICULT
988	USED	LONG	HARD		GROOVE	

Starr: Sample selected for functional analysis

N	Mat	Blank	PSI	R/I	RET	TYPE
-----	---	-----	----	----	----	-----
1	F	B	I	R	N	USED
11	F	F	S	R	Y	USED
14	F	F	S	R	Y	USED
19	F	B	I	R	N	NO TRACES
26	F	B	I	R	N	USED
43	F	F	S	R	L	PDSM?
48	F	B	S	R	L	USED OPP
49	F	B	S	R	L	USED
50	F	B	S	R	L	USED
51	F	F	I	R	L	USED
52	C	F	I	R	L	USED
53	F	F	I	R	L	NP
54	F	B	S	R	L	NO TRACES
55	F	B	I	R	L	USED
56	F	B	I	R	L	USED
82	C	CORE			N	TECHNO
85	C	B	S	R	N	USED
88	F	F	I	I	Y	USED
116	C	CORE			N	PDSM
119	C	CORE			N	PDSM
147	C	B	I	R	N	PDSM
149	C	B	I	R	N	PDSM
150	C	B	S	R	N	PDSM
151	C	F	S	R	N	USED?
152	C	F	S	R	L	TECHNO
153	C	B	S	R	N	PDSM
154	C	F	I	R	L	TECHNO
155	C	B	I	R	N	USED
156	C	F	S	R	L	USED?
157	C	B	I	R	N	USED
158	C	F	S	R	N	NO TRACES
159	C	B	S	R	N	USED
160	C	F	I	R	N	PDSM
161	C	F	I	R	L	PDSM
162	C	B	I	R	N	USED
163	C	B	I	R	N	USED
164	C	B	I	R	L	NO TRACES
165	C	B	I	R	N	USED
166	C	B	I	R	N	NP
167	C	B	I	R	N	USED OPP
168	C	B	I	R	N	NO TRACES
169	C	B	I	R	N	USED
170	C	CH	I		Y	USED
171	C	CH	I		L	USED
194	C	CORE			N	NO TRACES
195	C	CORE			N	PDSM

N	Mat	Blank	PSI	R/I	RET	TYPE
-----	----	-----	----	----	----	-----
196	C	CORE			N	USED
212	C	F	S	R	Y	USED?
253	F	CORE			N	TECHNO
254	F	F			Y	USED
255	F	CORE			N	NP
256	F	CORE			N	TECHNO
270	F	F	S	R	L	USED
291	F	B	S	R	L	USED
347	C	F	I	R	Y	USED
349	F	B	S	R	?	USED
350	F	B	I	R	Y	USED
353	F	F	S	R	L	USED
355	F	B	I	R	L	PDSM
356	C	B	I	R	L	USED OPP
360	C	B	I	R	N	USED
361	F	F	I	R	Y	USED
362	F	F	I	I	Y	?
363	F	F	I	R	L	NO TRACES
366	C	B	I	R	Y	USED
367	F	B	I	R	Y	USED?
368	F	B	I	R	Y	USED
369	F	B	I	R	Y	TECHNO
370	F	F	I	R	Y	PDSM
371	F	B	I	R	Y	USED
372	C	B	I	R	Y	TECHNO
375	C	F	I	R	Y	USED
379	F	B	S	R	L	USED
381	C	F	I	R	Y	USED
397	C	CORE/F	S		N	PDSM
399	C	CORE	I		N	USED
505	F	CORE			N	USED
620	C	CORE			N	NO TRACES
737	F	F	I	R	L	USED
738	C	F	I	R	L	USED
739	C	B	I	R	L	USED
744	C	B	I	R	Y	TECHNO
747	C	F	I	R	L	USED
748	C	B	I	R	L	USED
749	F	F	I	I	Y	NO TRACES
750	C	B	I	R	L	USED
751	F	B	I	R	Y	TECHNO
752	F	B	I	R	L	USED?
753	C	F	I	R	L	NO TRACES
754	C	F	I	R	Y	USED
755	F	F	I	I	Y	USED
756	F	B	S	R	L	PDSM
757	F	B	I	R	Y	NO TRACES
758	C	F	I	R	L	USED
761	C	F	I	R	Y	PDSM

N	Mat	Blank	PSI	R/I	RET	TYPE
-----	---	-----	---	---	---	-----
762	F	F	I	R	L	NO TRACES
763	F	F	I	I	L	NO TRACES
764	C	F	I	R	L	USED OPP
765	F	B	I	R	Y	USED
766	C	F	I	R	L	PDSM
767	C	F	S	R	L	PDSM
768	F	B	I	R	L	USED
769	C	F	I	R	Y	TECHNO?
771	F	F	I	R	L	TECHNO
772	C	B	S	R	L	PDSM
773	C	F	I	R	L	USED
774	F	F	I	R	L	USED
775	C	F	I	R	Y	NO TRACES
776	F	CORE		R	N	PDSM
777	F	F	I	R	L	USED
778	F	B	I	R	Y	USED
779	F	B	I	R	L	USED
780	F	B	I	R	L	PDSM
781	C	F	I	R	L	PDSM
782	C	A	I	R	L	NP
783	F	F	I	R	Y	PDSM
784	C	B	I	R	Y	TECHNO
785	F	B	I	R	L	NO TRACES
786	F	F	I	R	L	USED
787	C	B	I	R	L	USED
788	F	B	S	R	L	PDSM
789	F	B	S	R	L	USED
790	C	F	I	R	L	PDSM
791	C	F	I	R	L	USED
793	F	B	S	R	L	USED
794	F	B	I	R	L	USED
835	F	B	I	R	Y	USED
836	F	B	I	R	Y	TECHNO?
853	F	CORE			N	NO TRACES
854	F	F	S	R	L	PDSM
855	C	F	I	R	L	TECHNO
856	C	CORE			N	USED ?
857	C	B	I	R	L	NO TRACES
867	C	F	I	R	L	NO TRACES
869	C	F	I	R	L	PDSM?
872	F	F	S	R	L	USED
873	F	B	S	R	N	USED
874	C	B	I	R	L	PDSM
875	C	CORE			N	USED ?
877	C	CORE			N	USED ?
879	C	F	I	R	N	USED
880	C	F	I	R	N	USED
886	F	CORE			N	TECHNO
894	C	CORE			N	PDSM

N	Mat	Blank	PSI	R/I	RET	TYPE
-----	---	-----	---	---	---	-----
895	C	CORE			N	TECHNO
896	F	B	I	R	L	USED
897	C	B	I	R	N	USED
898	C	B	I	R	N	PDSM
899	C	CORE			N	USED ?
900	F	B	S	R	N	USED ?
901	F	B	I	R	N	USED
902	F	B	I	R	L	NP
903	F	F	I	R	N	?
904	C	CORE			N	PDSM
910	C	CORE			N	NP
911	?	CORE			N	NP
912	F	B	S	R	N	USED
913	F	F	I	R	L	USED
914	F	F	S	I	N	NO TRACES
915	F	F	I	R	N	USED
916	F	B	I	R	N	USED
917	F	B	I	R	N	USED
918	F	CORE			N	USED
968	F	B	I	R	Y	TECHNO
984	F	B	I	R	Y	NO TRACES
985	C	B	I	R	Y	NO TRACES
988	C	F	I	R	Y	USED OPP
989	C	B	I	R	Y	PDSM

Appendix C3

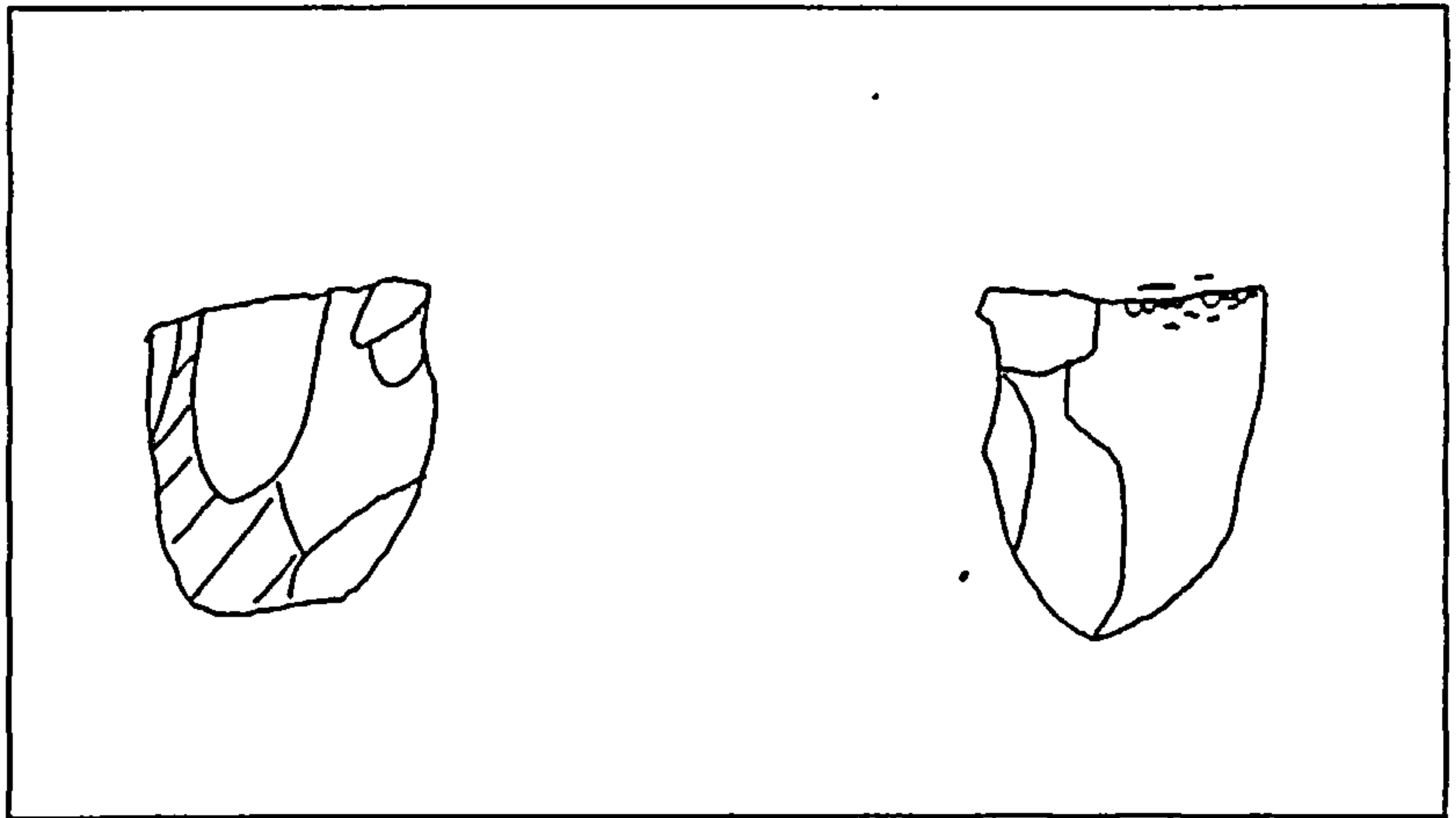
Gleann Mor Basic data

Refer to appendix B for information on recording system

All the pieces interpreted as "used" are described individually, giving a brief textual description of the more significant features to allow quick assessment of these pieces. More detailed information is kept on archive in the Dept of Archaeology, University of Edinburgh.

Following this piece by piece information are various summary tables detailing the complete sample.

Ref: GM0063
Type: PLATFORM
Blank: CORE
Mat: FLINT
Dim: 25x28x22
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A

Edge Angle: thick

Traces:

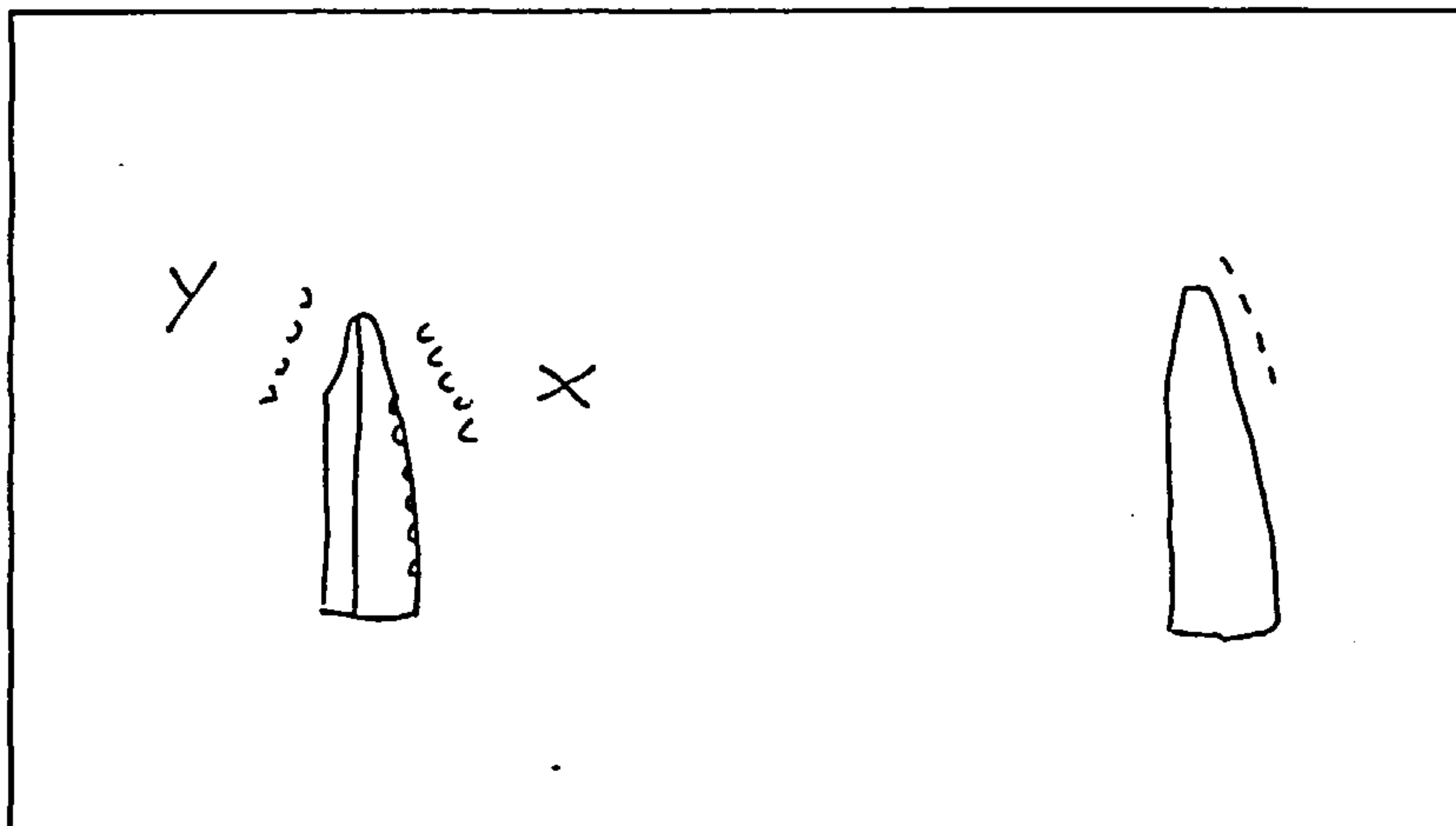
Edge damage not recorded because of platform
preparation scars

Restricted patchy polish on and away from edge.
Polish is smooth flat, partially linked, developed,
with abrupt edges and common small irregular pits.
Associated are parallel short medium narrow rare
striations.

Interpretation: used. Probably long motion

Comments: shadowing suggests transverse motion, difficult

Ref: GM0112
Type: ED
Blank: BLADE
Mat: FLINT
Dim: 12x3x2
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A

Edge Angle: point

Traces:

Extreme tip lost

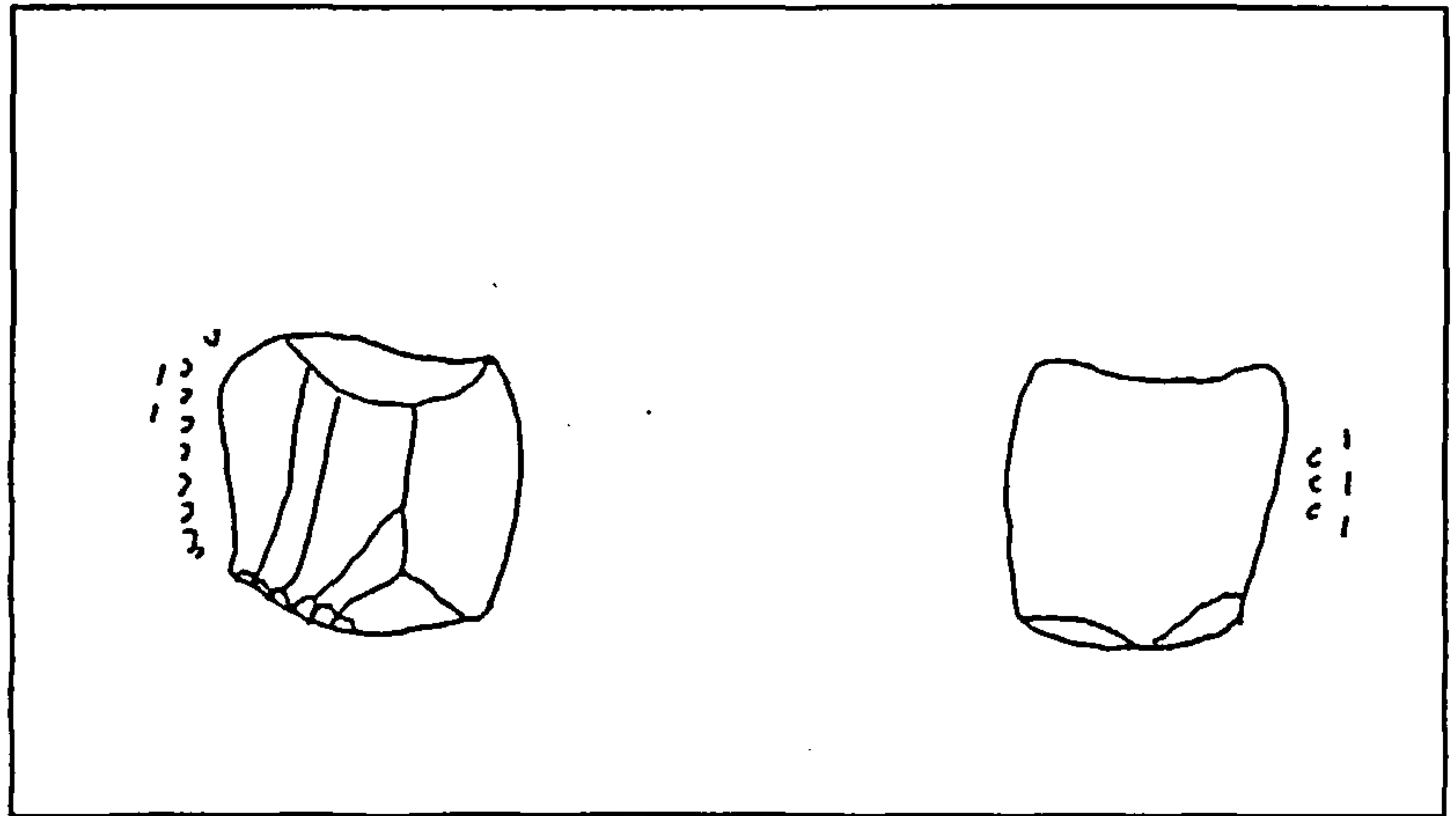
At X: common clustered medium to small mixed
termination deep scars.

At Y: common clustered small mostly feather
terminating deep scars

Polish A: restricted patches on edge. Polish is
smooth invasive, allover, developed, with sharp
edges and no internal features.

Interpretation: Distal point used, boring, soft material
Comments:

Ref: GM0132
Type:
Blank: FLAKE
Mat: FLINT
Dim: 18x20x8
Qual: EXC
Cond: SP



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: medium

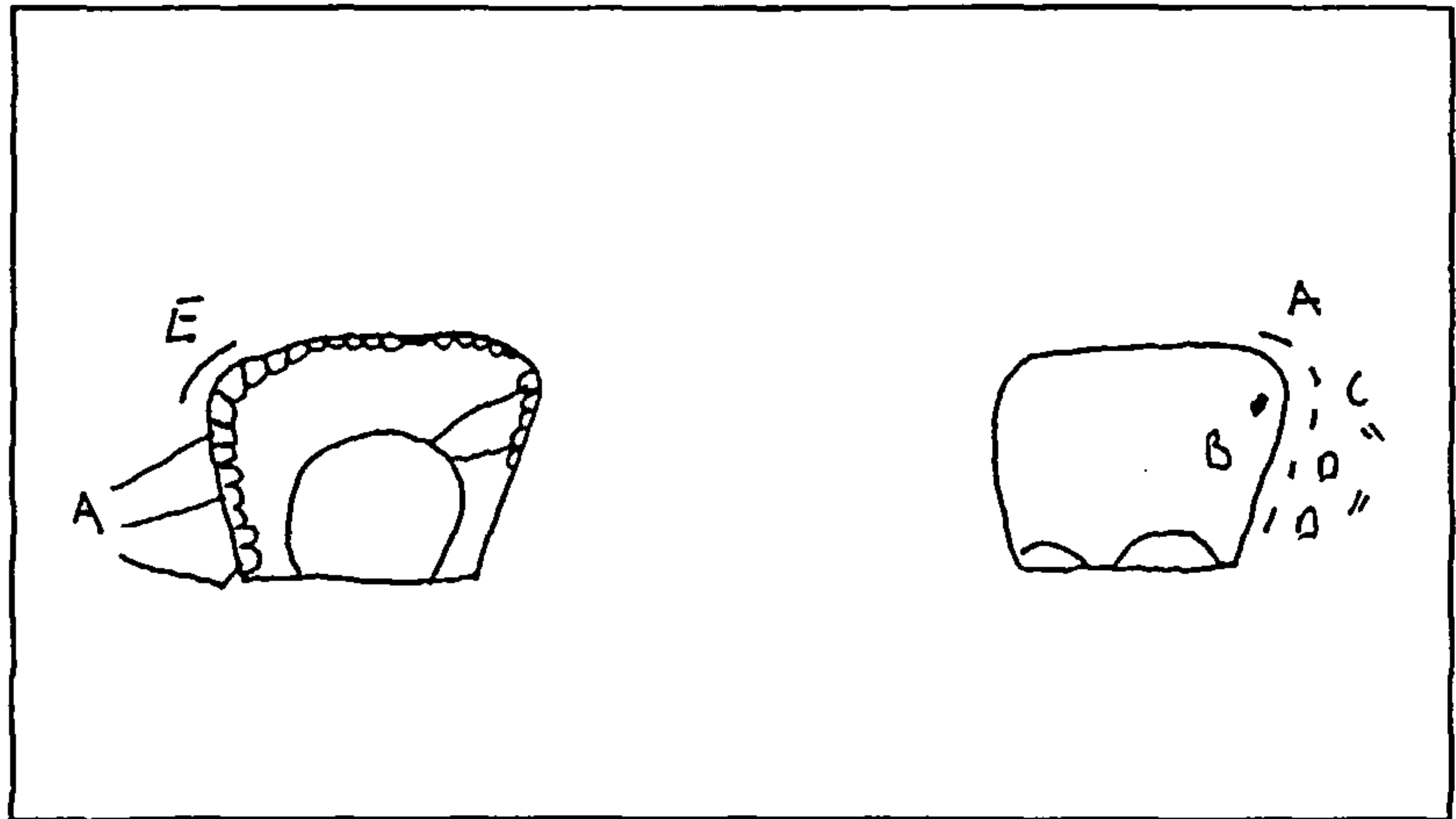
Traces:

Dorsal side a: occasional clustered and layered large to medium mostly step terminating deep scars associated with a patchy (and linear along ridges) polish on edges and interior face. Polish is smooth invasive to reticulated, partially linked, poor, widely variable, with gradual edges and frequent minute irregular pits.

Ventral side a: occasional clustered small mostly feather terminating deep scars, associated with polish as on dorsal

Interpretation: side a used, long motion?, opp use?
Comments: difficult because of developing patina

Ref: GM0138
Type: SCRAPER
Blank: FLAKE
Mat: FLINT
Dim: 18x25x8
Qual: POOR
Cond: PATINA



Material: Grain: M Homog: V Crys: O Topo: F Fissures: A

Edge Angle: thick

Traces:

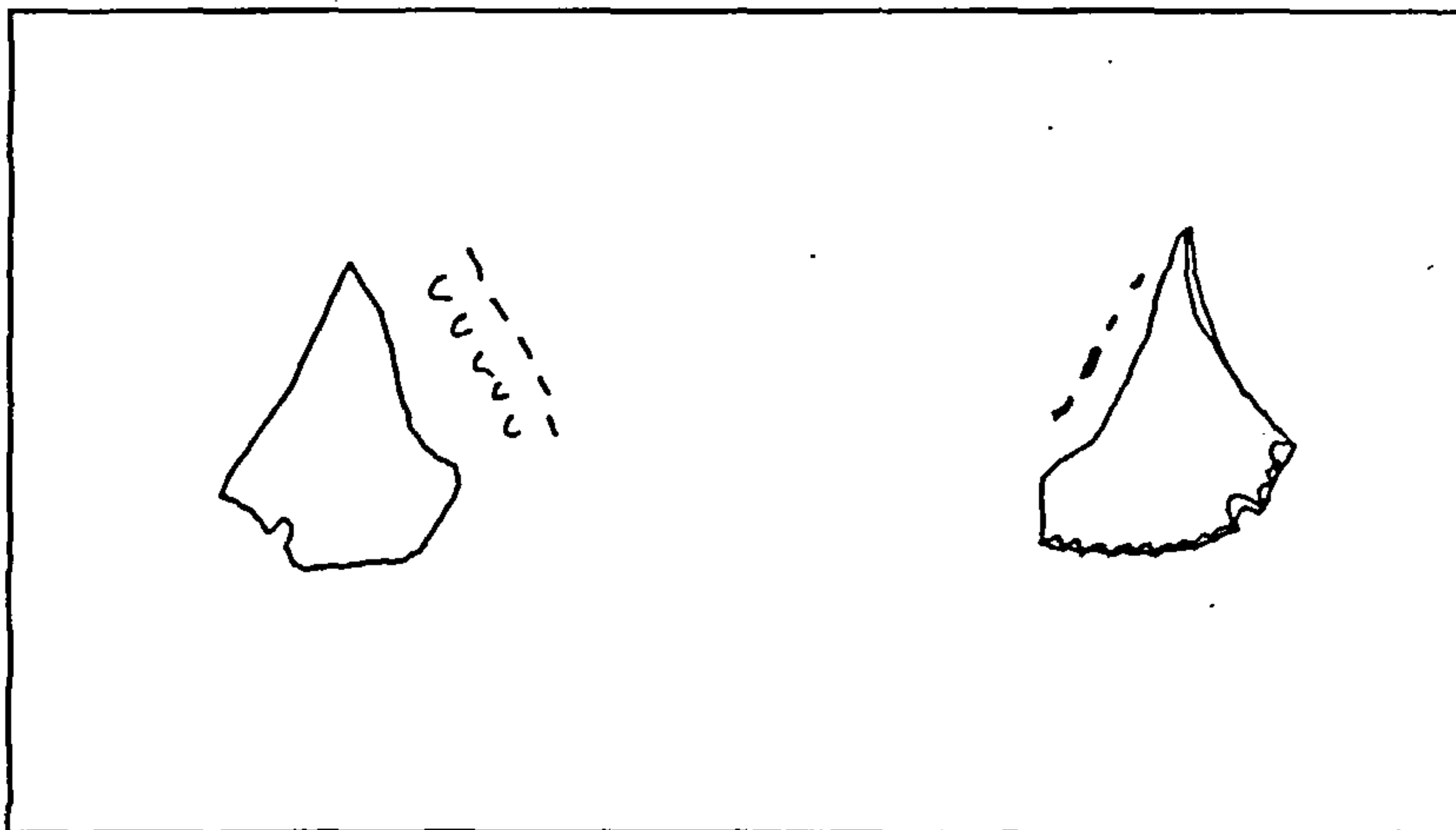
Edge damage not recorded due to retouch

Dorsal side a: polish A: patches on and away from edge. Polish is smooth domed, partially linked, developed, with fairly sharp edges and occasional medium irregular pits. Only formed on high points of microtopography. Also polish E: patchy polish on edge. Polish is smooth domed, allover, intense, bright, with gradual edges and no internal features, forms edge bevel

Ventral side a: polish A, and polish B: restricted patches away from edge. Polish is smooth flat allover, developed, with abrupt edges and rare medium irregular pits. Also polish C: patchy polish on edge. Polish is smooth reticulated, scattered, with sharp edges and frequent variable irregular pits. Associated with 450 medium deep medium striations. Also with polish D: patchy polish on edge. Polish is smooth flat, partially linked, developed, with sharp edges and frequent variable irregular pits. Associated with parallel long deep fine numerous striations.

Interpretation: side a used. long motion
Comments: not as scraper

Ref: GM0144
Type: MISC RET
Blank: FLAKE
Mat: FLINT
Dim: 15x13x3
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: medium

Traces:

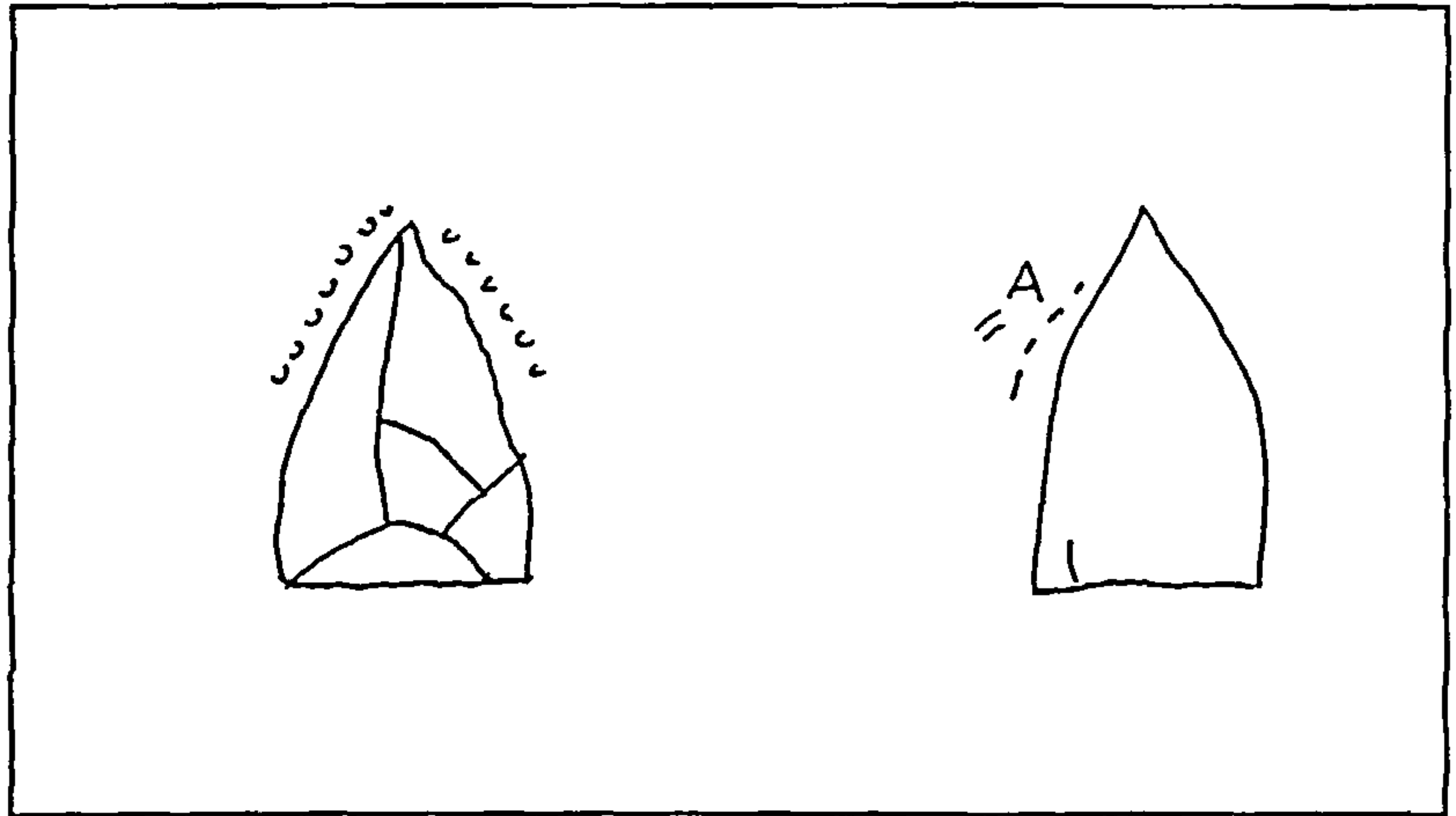
Dorsal side b: common clustered medium mostly feather terminating deep scars associated with restricted patchy polish away from edge. Polish is smooth flat, all over, developed, with sharp edges and occasional medium irregular pits. Also with a restricted narrow linear polish along edge. Polish is smooth domed invasive, partially linked, with gradual edges and occasional medium irregular pits.

Ventral side b: no edge damage. polish is restricted narrow linear on edge. Polish is smooth invasive, partially linked, poor, with gradual edges and no internal features.

Interpretation: side b used.

Comments: motion? all good features on one face, most likely transverse.

Ref: GM0170
Type: MISC RET
Blank: FLAKE
Mat: FLINT
Dim: 21x18x7
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: medium

Traces:

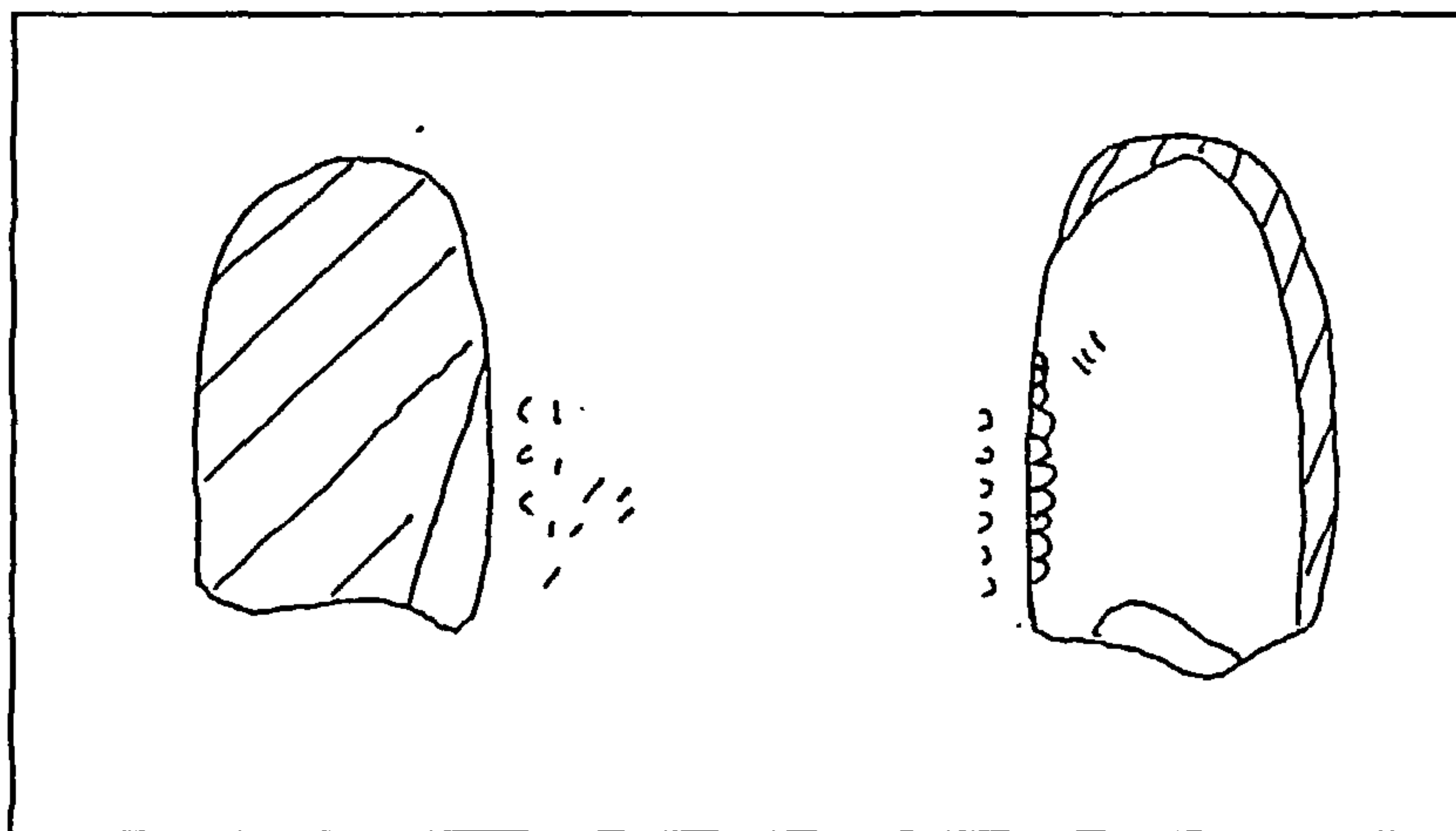
Dorsal side b: difficult, pos edge damage, pos fine retouch. No polish.

Ventral side b: occasional clustered, medium to small, feather terminating, deep scars, associated with restricted linear polish along edge. Polish is smooth domed, partially linked, with gradual edges and common minute irregular pits. Associated with parallel long deep narrow striations.

Interpretation: side b used, long motion??

Comments: difficult because of possible retouch

Ref: GM0171
Type: ED
Blank: FLAKE
Mat: FLINT
Dim: 42x30x12
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures: A

Edge Angle: medium

Traces:

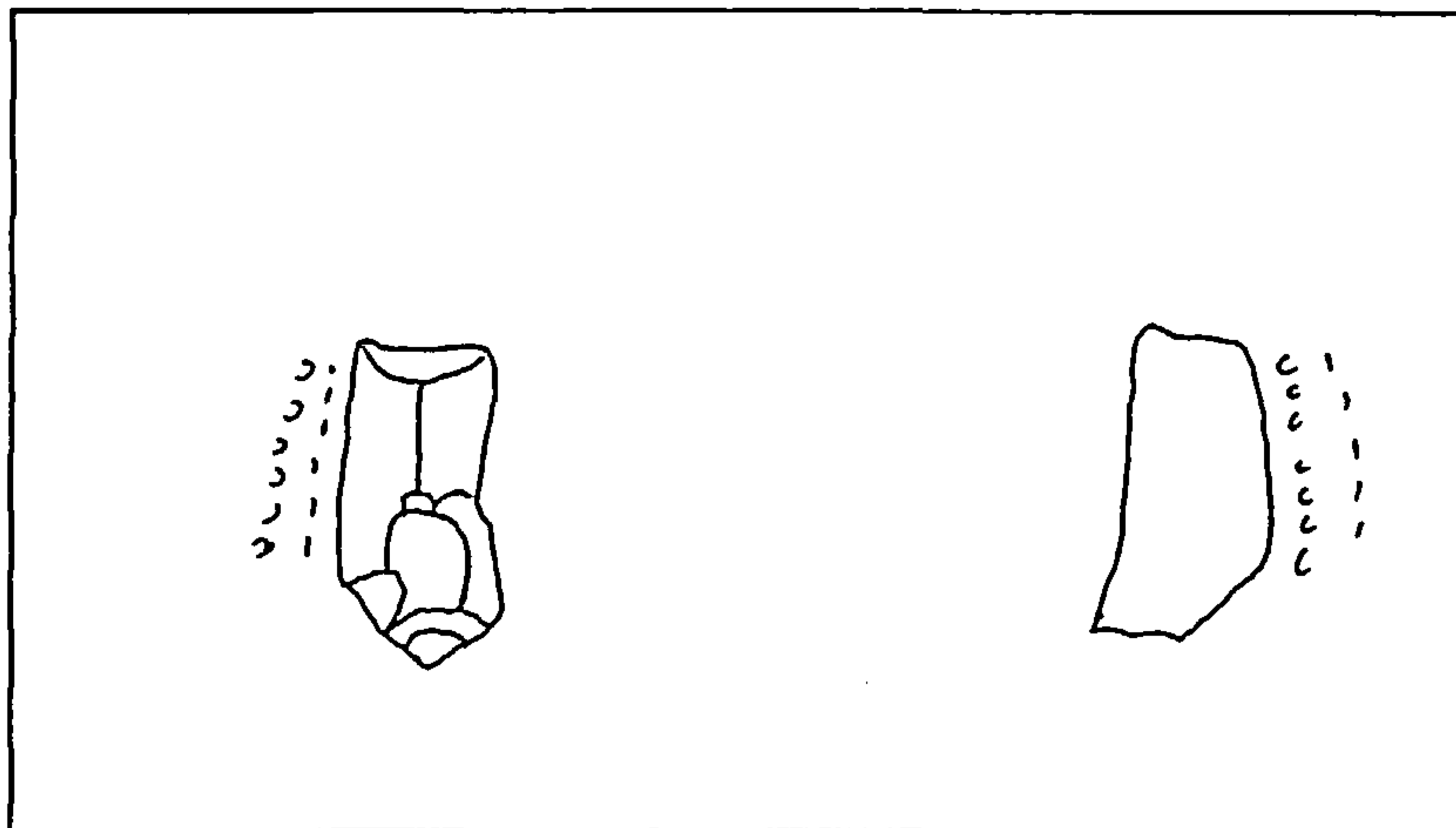
Dorsal side b: common clustered small to minute step terminating deep scars, associated with a restricted narrow linear polish. Polish is smooth domed, partially linked, with gradual edges and no internal features. Associated with 450 short medium fine striations.

Ventral side b: regular clustered and layered large to small mostly feather terminating mostly shallow scars, associated with linear (450) polish on interior. Polish is smooth reticulated, partially linked, with sharp edges and no internal features, Alos with restricted patch on interior. Polish is smooth flat, allover, developed, bright, with abrupt edges and occasional medium irregular pits.

Interpretation: side b used, probably transverse, soft material, low angle, ventral leading

Comments: edge damage to shallow and feather to be minor retouch.

Ref: GM0183
Type:
Blank: FLAKE
Mat: FLINT
Dim: 19x11x3
Qual: GOOD
Cond: PATINA



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: medium

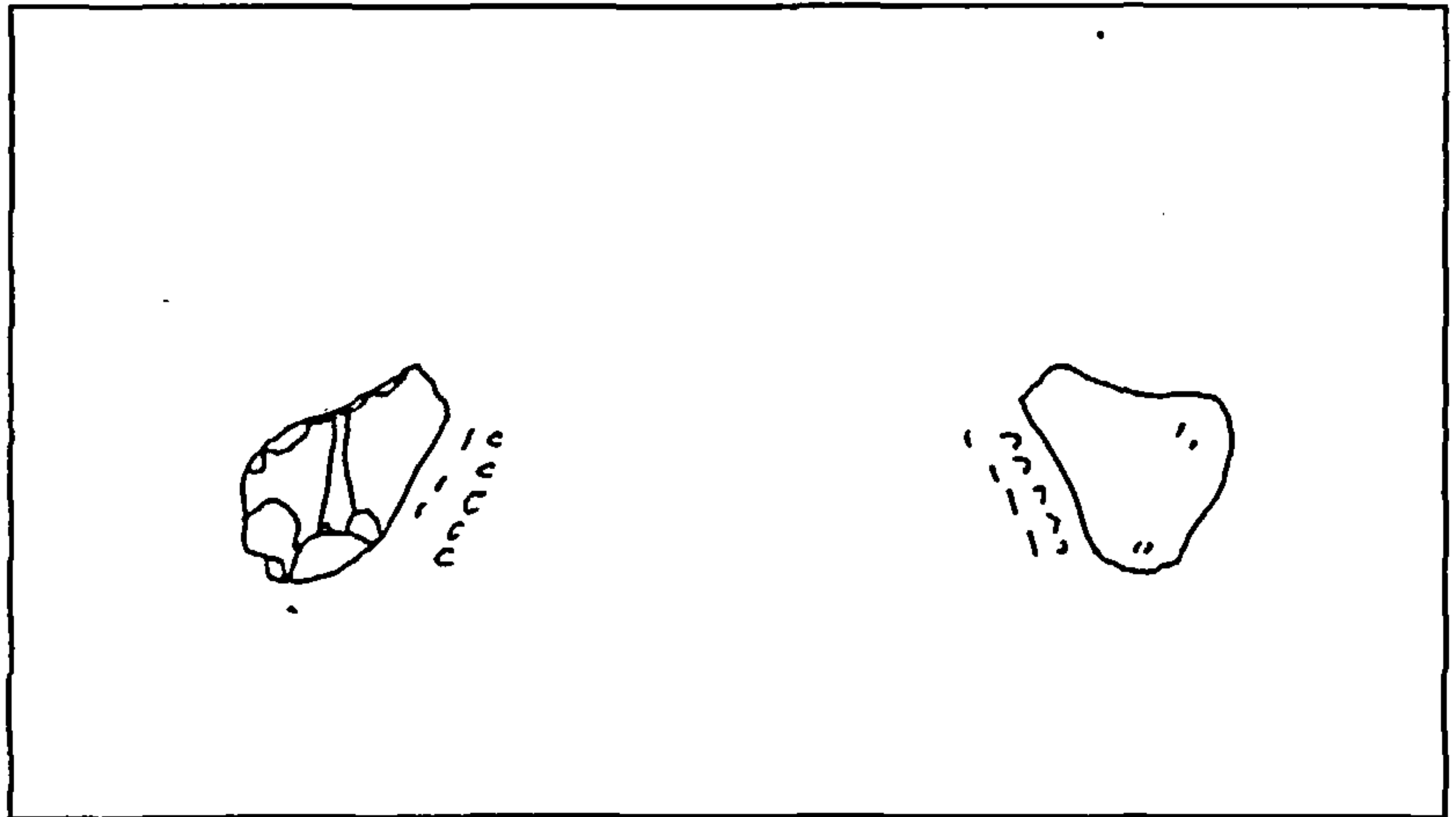
Traces:

Side a, both face very similar: frequent clustered medium to small feather terminating deep scars with snaps. Associated with A: restricted narrow linear polish along edge. Polish is smooth domed, all over, developed, bright, with sharp edges and no internal features. Also with B: patchy polish on edge. Polish is smooth flat reticulated, scattered, developed, with sharp edges and no internal features. And polish D: restricted patches on edge. Polish is smooth flat, partially linked, intense, bright, with sharp edges and occasional small circular pits.

Interpretation: side b used, long motion

Comments:

Ref: GM0185
Type: TRUNC
Blank: FLAKE
Mat: FLINT
Dim: 12x10x3
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: thick

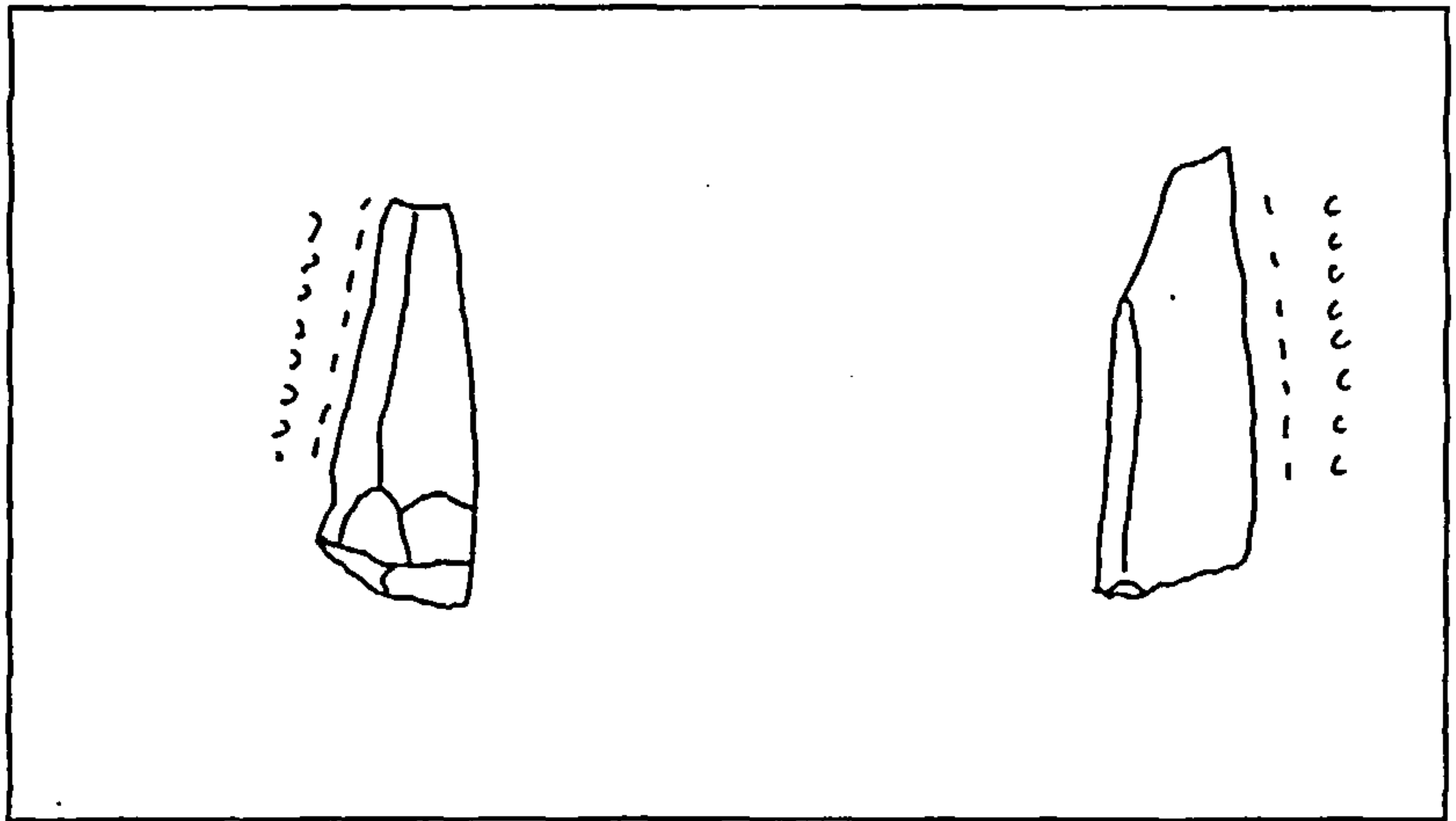
Traces:

Dorsal side b: regular clustered medium to small mixed termination mostly deep scars with snaps, associated with patchy polish on edge. Polish is rough invasive, allover, developed, variable, with soft edges and frequent large to medium irregular pits.

Ventral side b: numerous clustered small feather terminating deep scars with snaps, associated with patchy polish on edge. Polish is smooth flat reticulated, scattered, with sharp edged and frequent medium irregular pits.

Interpretation: side b used, probably long motion
Comments:

Ref: GM0205
Type: MISC RET
Blank: FLAKE
Mat: FLINT
Dim: 22x12x3
Qual: GOOD
Cond: BURNT



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
O

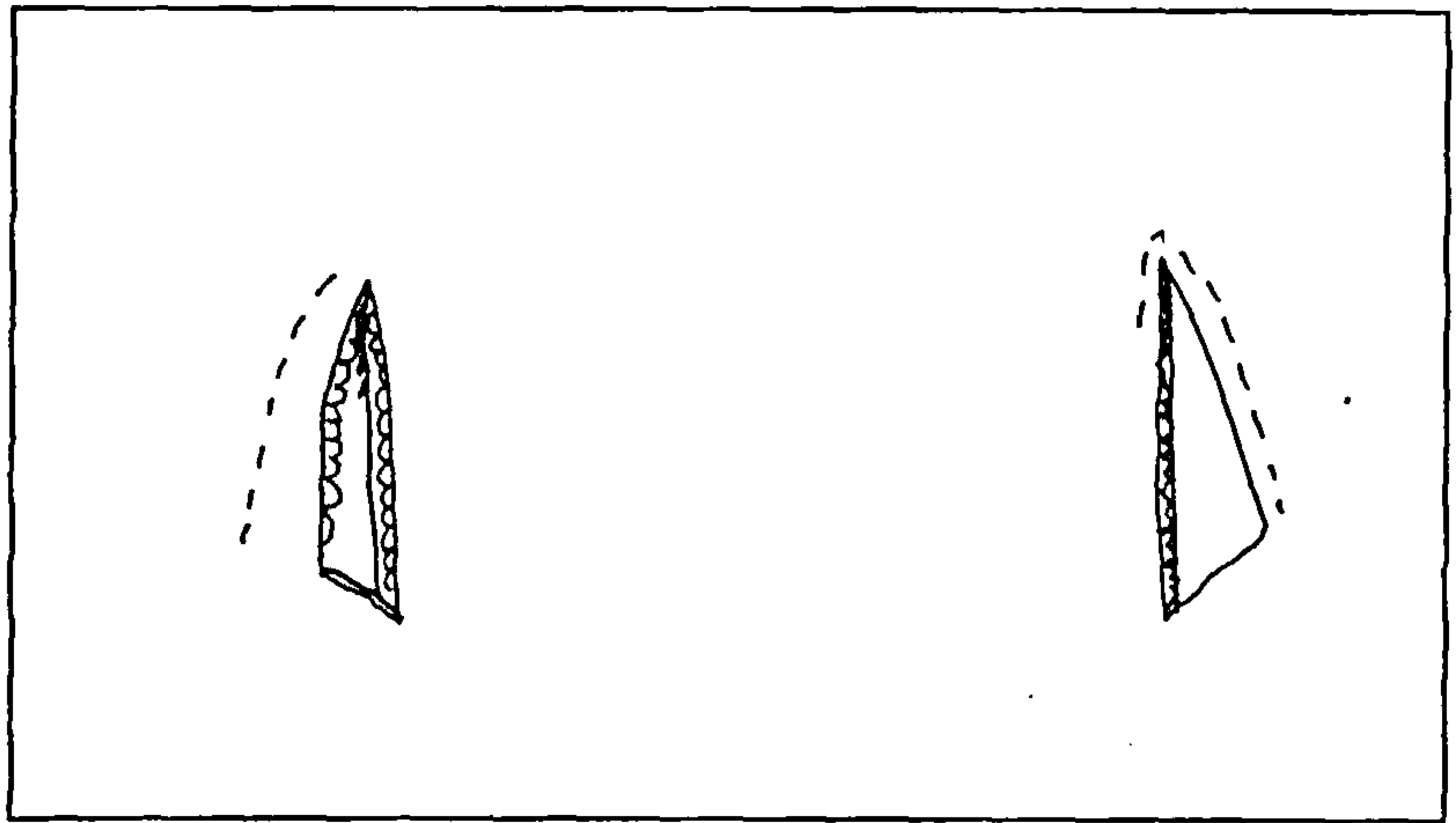
Edge Angle: medium

Traces:

Side A, both faces virtually identical: frequent clustered small to medium mostly feather terminating deep scars with snaps. On dorsal some poor indication of bidirectionality. Associated with narrow linear polish along edge. Polish is smooth flat, domed, invasive, partially linked, widely variable, with no internal features.

Interpretation: side a used, long motion, pos
bidirectional, soft material
Comments:

Ref: GM0239
Type: MICRO
Blank: BLADE
Mat: FLINT
Dim: 14x4x3
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: thick

Traces:

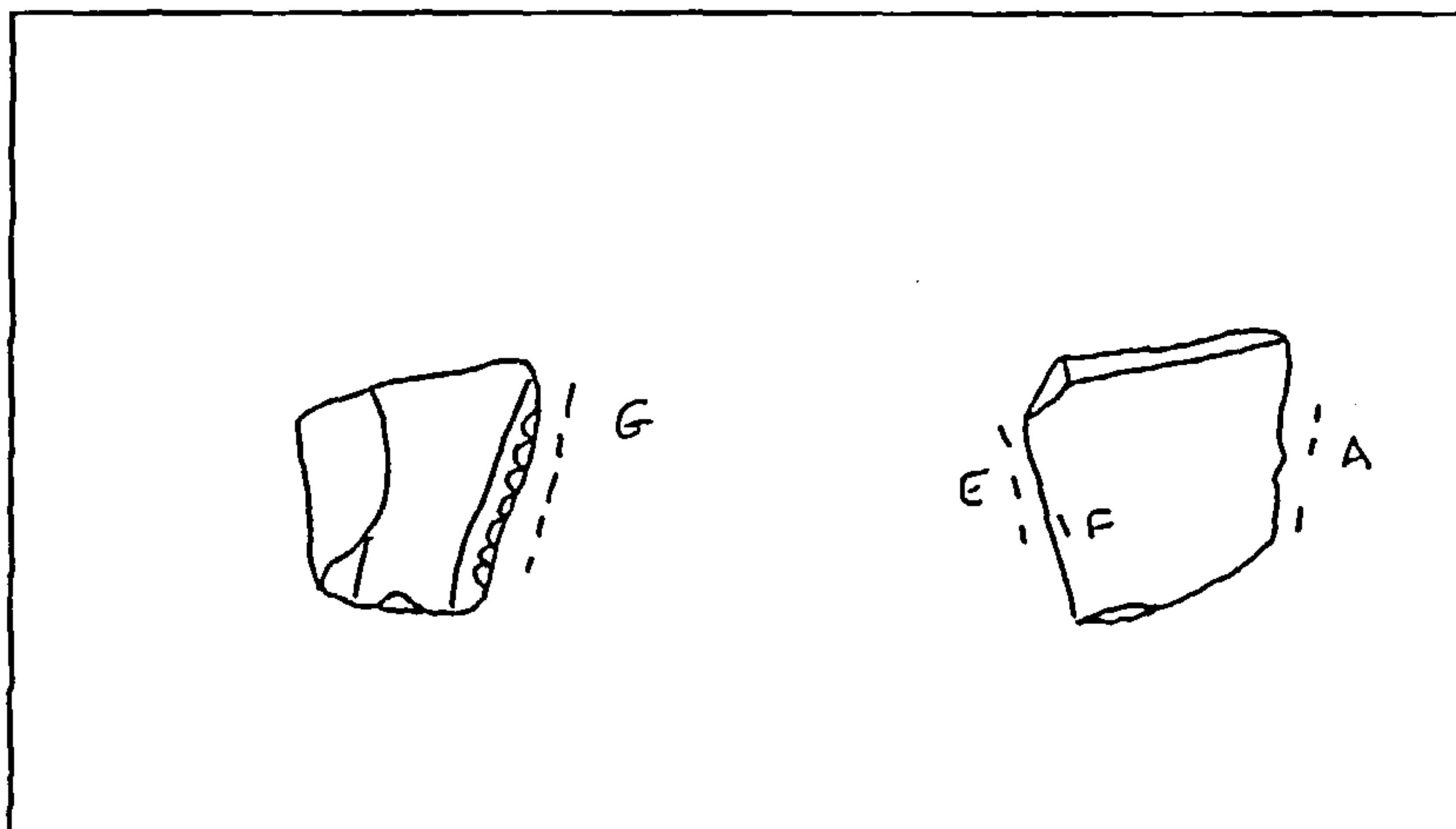
Edge damage not recorded because of retouch

Dorsal: patchy polish on interior face. Polish is smooth domed, partially linked, with gradual edges and occasional medium circular pits. Also restricted narrow linear polish along ridges. Polish is smooth domed, partially linked, with gradual edges and occasional medium irregular pits.

Ventral: Patchy polish along edge. polish is smooth domed, partially linked, with gradual edges and occasional medium irregular pits. Also patches on interior. Polish is smooth domed, scattered, poor, with gradual edges and occasional medium irregular pits

Interpretation: used, distal point, pierce
Comments:

Ref: GM0348
Type: SCRAPER
Blank: FLAKE
Mat: FLINT
Dim: 17x19x4
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: a = medium, b = acute

Traces:

Edge damage not recorded because of retouch.

Polish A: restricted patchy polish on edge. polish is smooth invasive, partially linked, with gradual edges and no internal features.

Polish E: restricted patchy polish on edge. Polish is smooth domed (and invasive), all over, developed, with sharp edges and frequent minute circular pits.

Polish F: restricted patchy polish away from edge. Polish is smooth flat, partially linked, developed, with sharp edges and common minute irregular pits

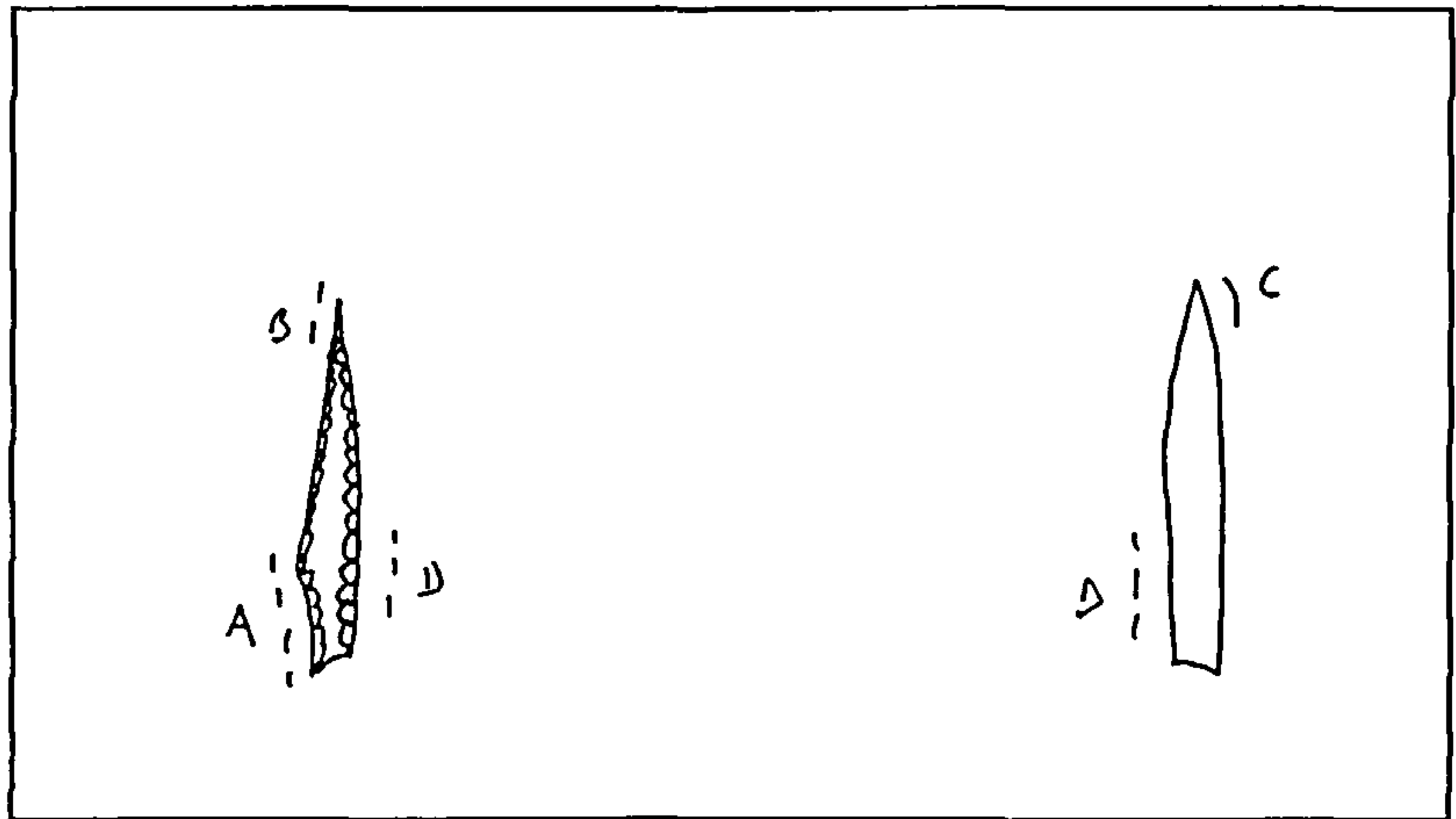
Polish G: Patchy polish on and away from edge. Polish is smooth reticulated (domed), partially linked, variable, with gradual edges and occasional minute irregular scars. Generally restricted to raised parts of microtopography.

Other traces associated with techno and NUW causes

Interpretation: used

Comments:

Ref: GM0409
Type: MICRO
Blank: BLADE
Mat: FLINT
Dim: 18x3x2
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: C Topo: F Fissures:
A

Edge Angle: thick + point

Traces:

Edge damage not recorded because of retouch

Polish A: restricted linear polish along edge.
Polish is smooth invasive, partially linked, poor,
with gradual edges and no internal features.

Polish B: patchy polish on edge. Polish is smooth
invasive, partially linked, poor, with gradual edges
and no internal features.

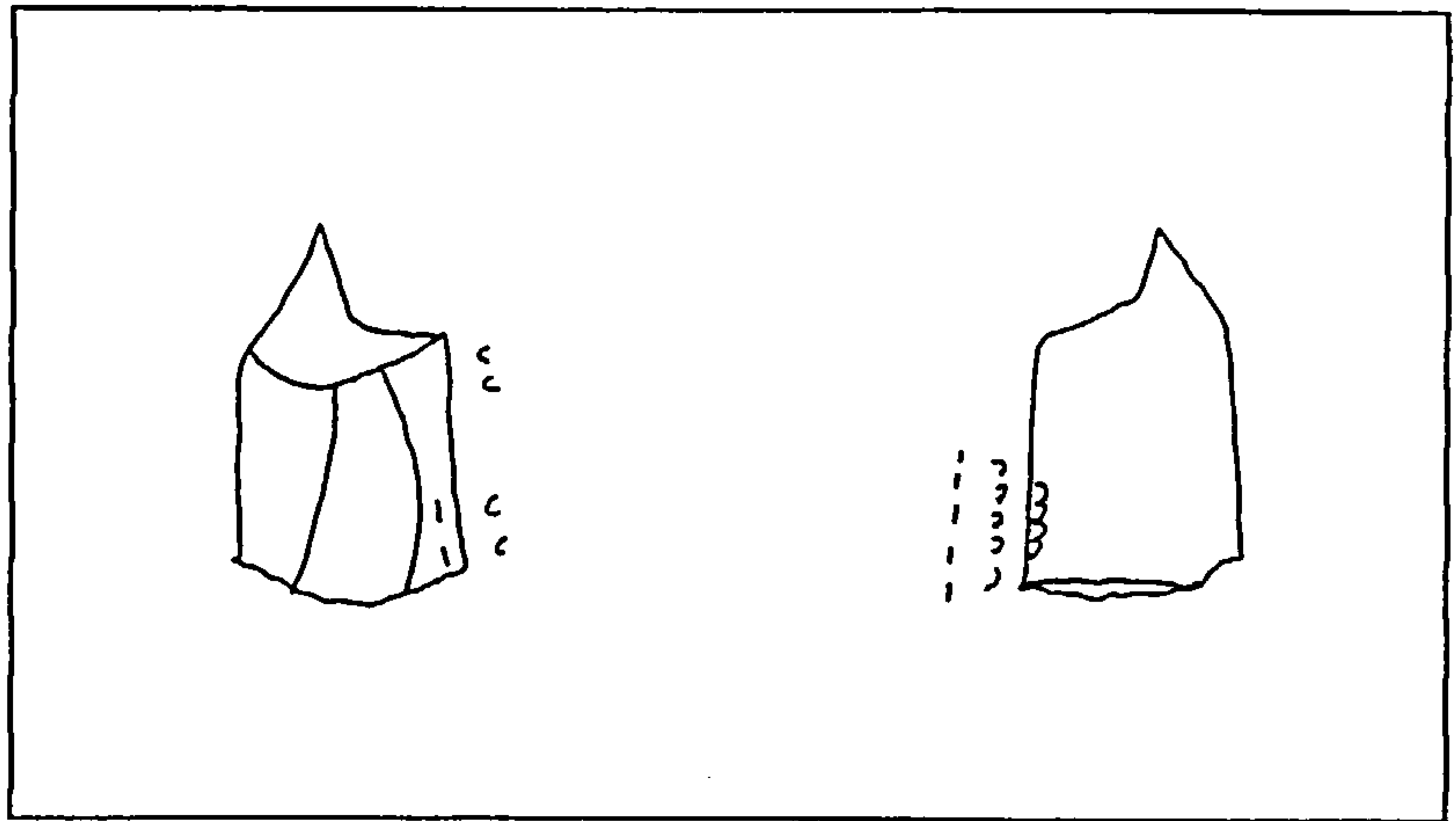
Polish C: patchy spread of polish along edge. Polish
is smooth invasive, partially linked, with gradual
edges and no internal features.

Polish D: Restricted linear polish, away from and
parallel to edge. Polish is smooth invasive,
partially linked, poor, with gradual edges and no
internal features.

Interpretation: used

Comments: no detailed interpretation, traces generally
poor, and difficult to interpret as a single function.
Possibly a combination of hafting at proximal and use at
distal.

Ref: GM0508
Type: ED
Blank: FLAKE
Mat: FLINT
Dim: 21x14x3
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: medium

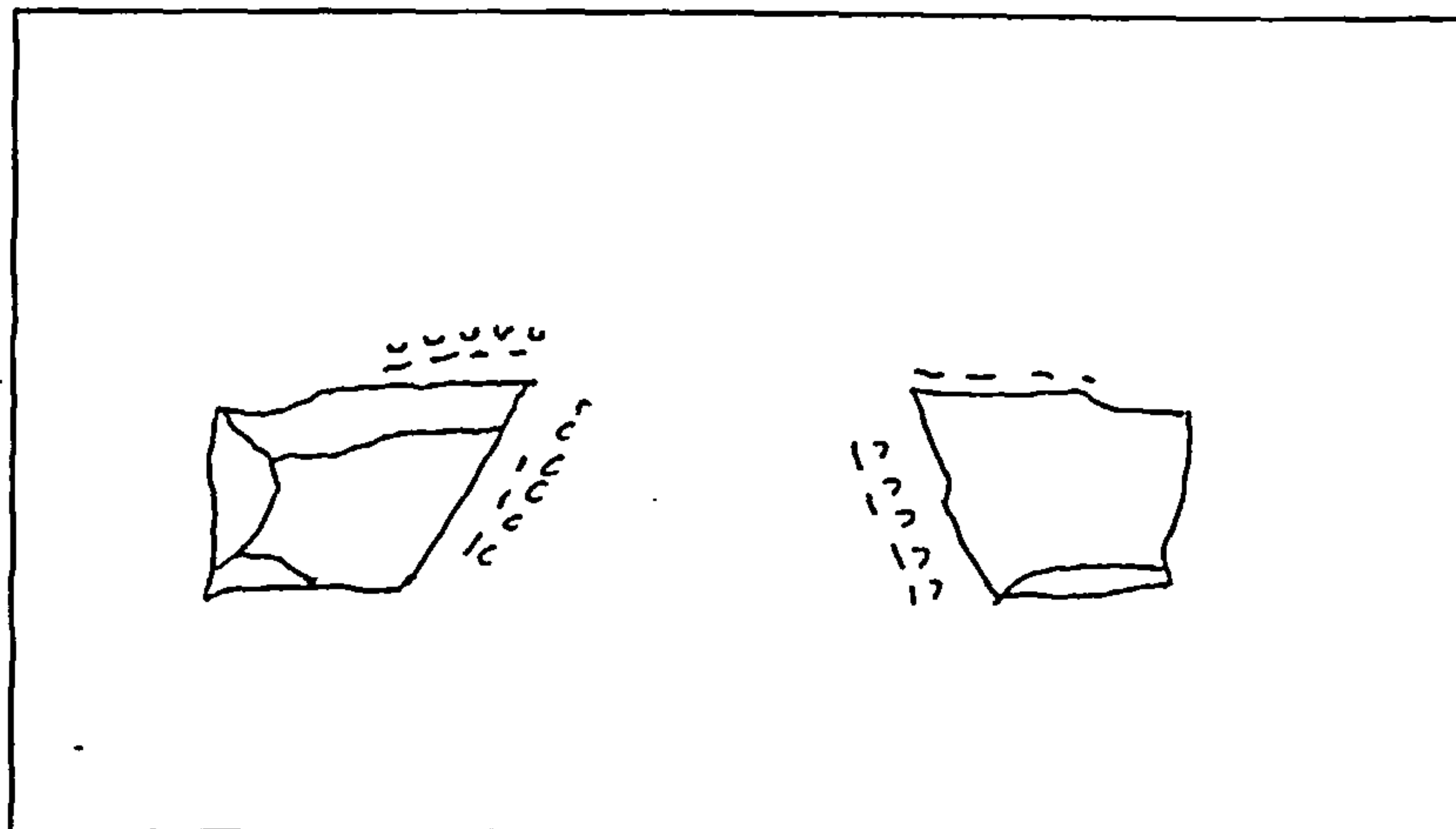
Traces:

Dorsal side b: occasional clustered small feather terminating deep scars. Associated with patchy spread of polish away from edge. Polish is smooth flat reticulated, scattered, developed, bright, with abrupt edges and occasional medium irregular pits.

Ventral side b: common clustered medium mostly feather terminating deep scars, associated with patchy polish on edge. Polish is smooth flat, partially linked, intense, bright with abrupt edges and occasional large irregular pits. Also with patchy spread away from edge. Polish is smooth flat reticulated, scattered, developed, bright, with abrupt edges and occasional medium irregular pits.

Interpretation: side b used, longitudinal
Comments:

Ref: GM0606
Type: ED
Blank: FLAKE
Mat: FLINT
Dim: 21x13x6
Qual: GOOD
Cond: FLINT



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: medium and point

Traces:

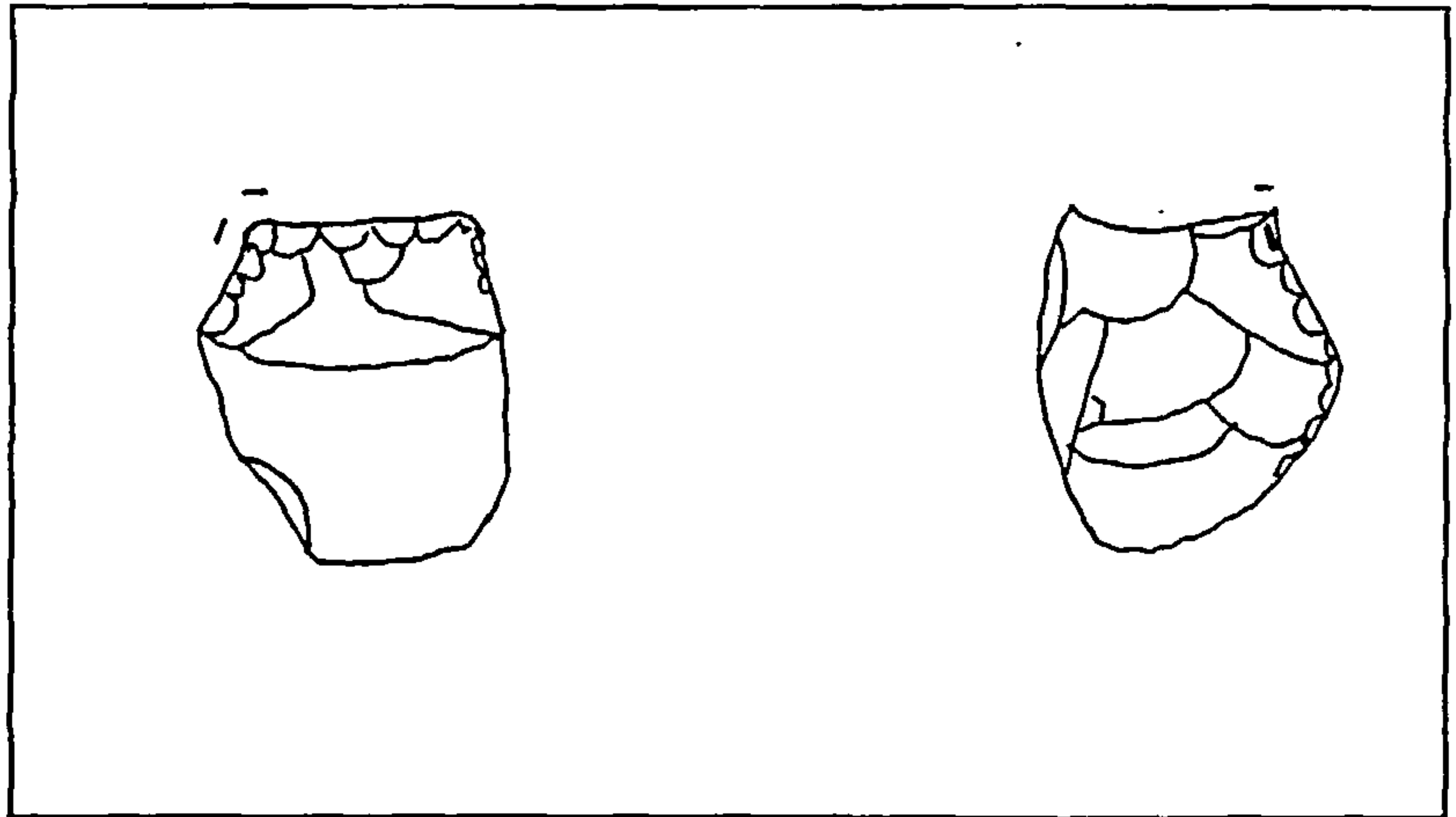
Dorsal: numerous clustered large to small mostly
feather terminating mostly deep scars with snaps.

Ventral: occasional clustered small mostly feather
terminating deep scars.

Polish identical on both faces: patchy spread along
edges. Polish is smooth domed, partially linked,
poor, variable, with gradual edges and occasional
medium irregular pits.

Interpretation: used, distal/side b corner
Comments:

Ref: GM0633
Type: SCALAR
Blank: CORE
Mat: FLINT
Dim: 24x24x11
Qual: MEDIUM
Cond: PATINA



Material: Grain: M Homog: H Crys: O Topo: F Fissures:
O

Edge Angle: thick

Traces:

Edge damage impossible to separate from core damage

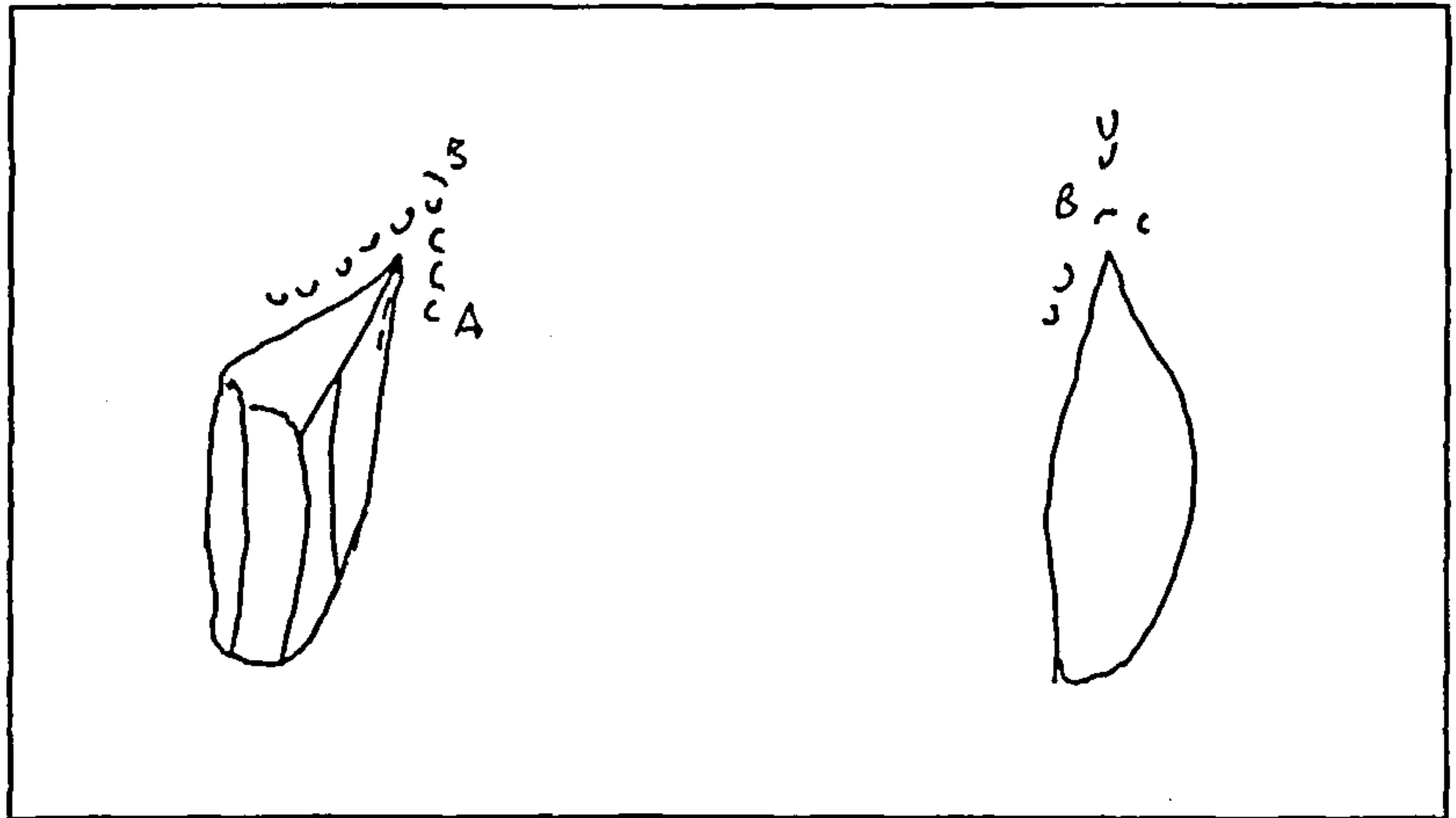
Polish A: restricted patchy polish on edge. Polish is smooth domed, allover, developed, bright, with gradual edges and frequent minute circular pits.

Polish B: patchy polish away from edges. Polish is smooth domed invasive, partially linked, developed, variable with gradual edges and occasional small irregular pits

Interpretation: pos use of corner

Comments: very difficult because of both patina and techno effects

Ref: GM0825
Type:
Blank:
Mat: FLINT
Dim:
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A

Edge Angle: thick point

Traces:

Dorsal edge damage: common clustered and layered large to small mostly step terminating deep scars. Running from tip, with crushing at extreme tip.

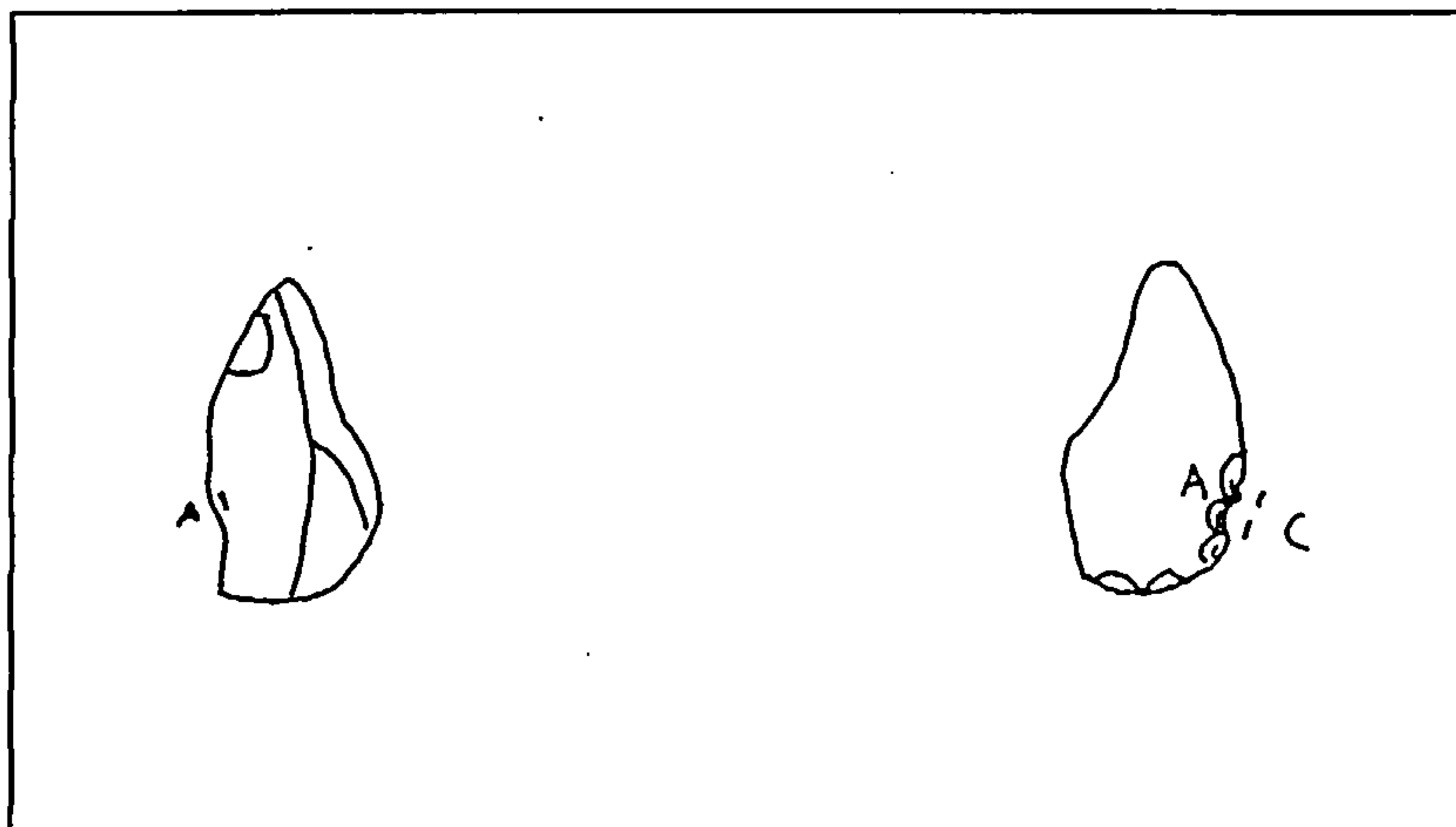
Ventral edge damage: common clustered small step terminating deep scars. At extreme tip damage initiated from extreme tip.

Polish A: restricted patchy polish away from edge. Polish is smooth flat, partially linked, developed, with abrupt edges and no internal features.

Polish B: patchy polish along edge. Polish is rough reticulated, partially linked, with gradual edges and no internal features. Also away from edge on high points of microtopography.

Interpretation: point used, bore, hard material
Comments: very clear

Ref: GM0832
Type: MISC RET
Blank: FLAKE
Mat: FLINT
Dim: 16x10x5
Qual: GOOD
Cond: SP



Material: Grain: M Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: thick

Traces:

No micro edge damage noted. Ventral face has several macro scars.

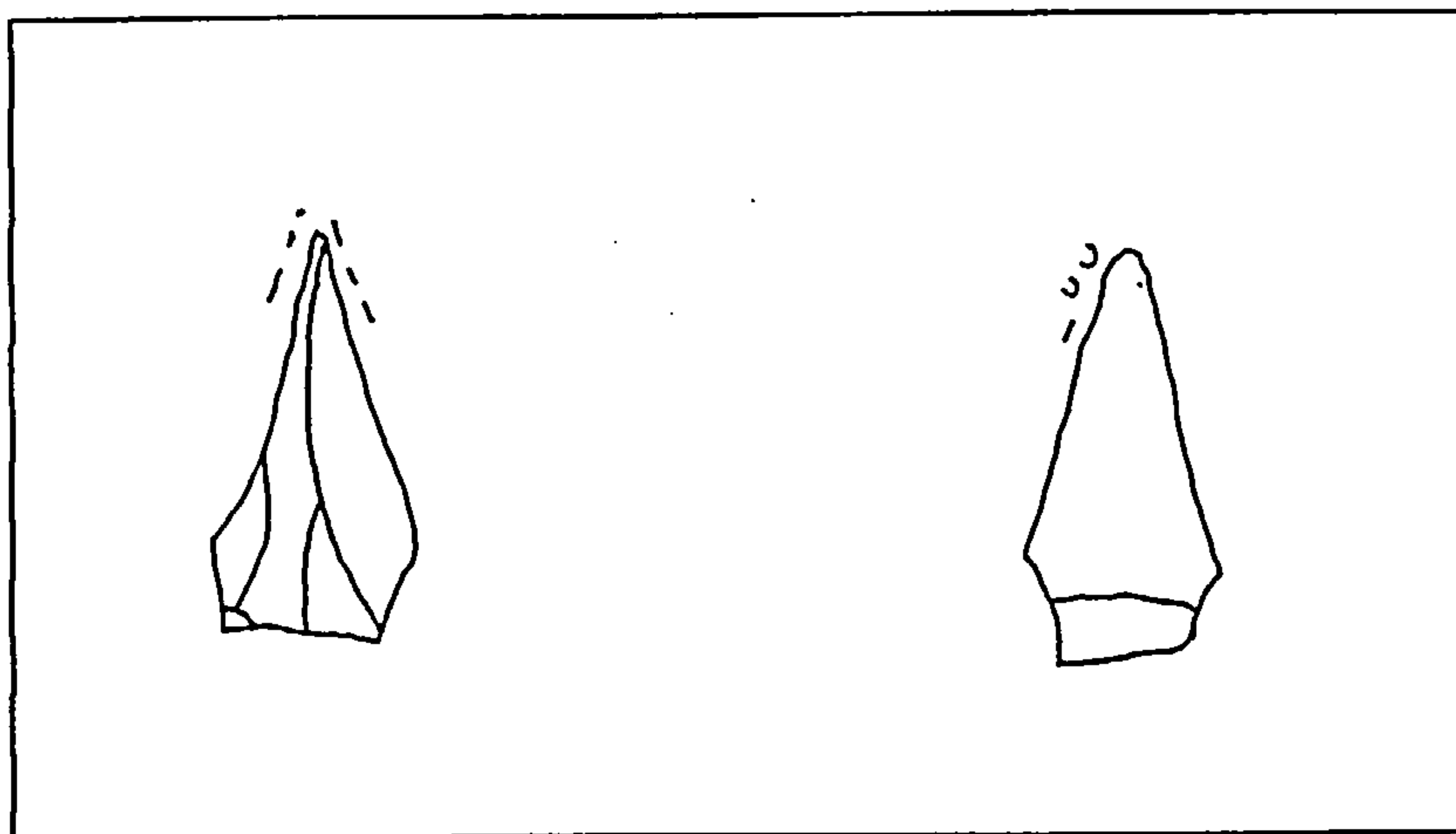
Polish A: patchy polish away from edge. Polish is smooth flat, partially linked, developed, with sharp edges and occasional variable irregular pits. Associated are perpendicular long deep medium to narrow (some random) regular striations.

Polish C: patches on and away from edge. Polish is smooth domed invasive, partially linked, developed, with gradual edges and common variable irregular pits.

Interpretation: side b used.

Comments: unifacial saw?

Ref: GM0902
Type:
Blank: FLAKE
Mat: FLINT
Dim: 26x15x8
Qual: GOOD
Cond: SP



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: thick point

Traces:

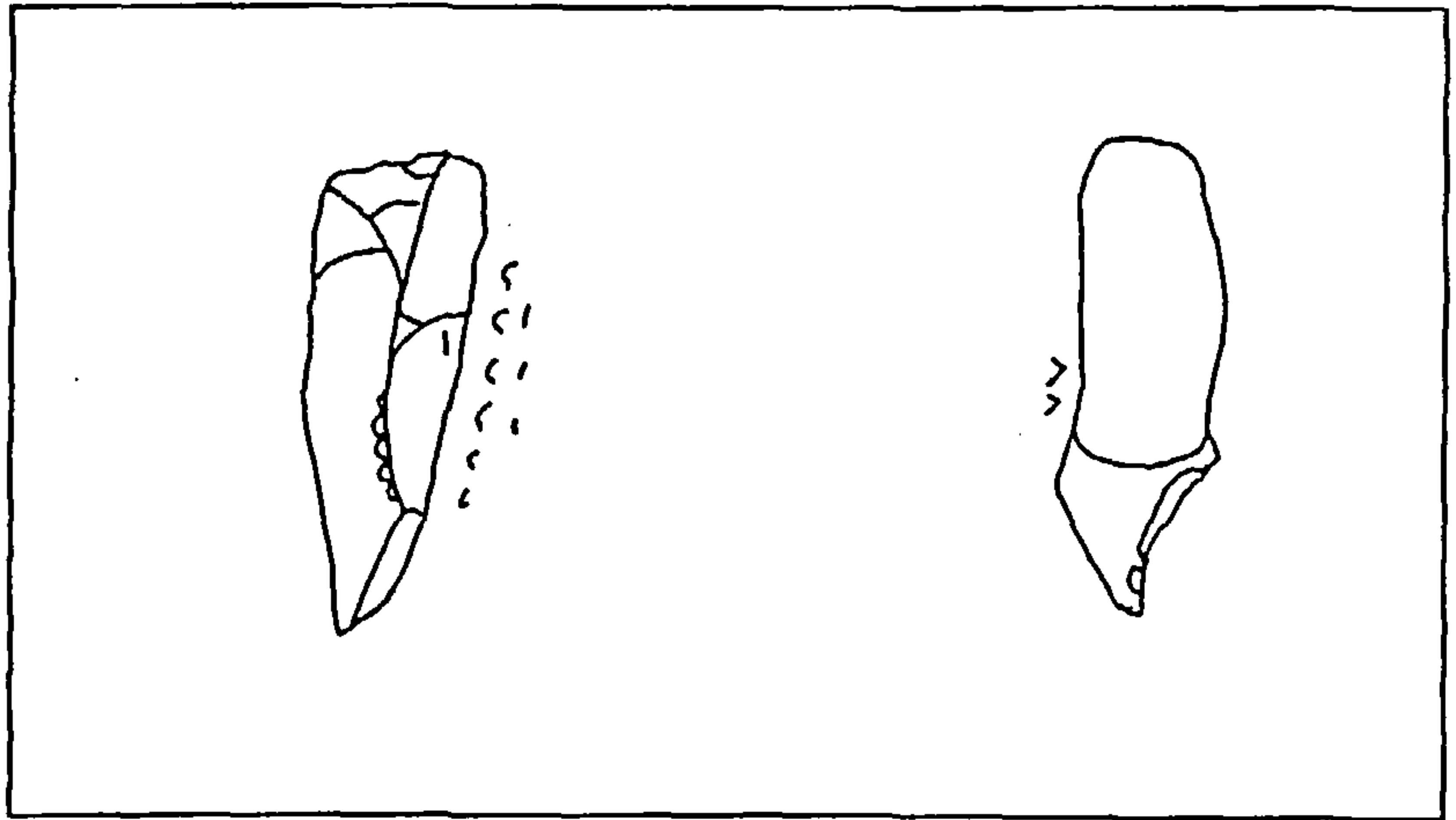
Edge Damage: occasional clustered and layered large
step terminating deep scars, with some crushing

Polish: restricted patches on edge. Polish is smooth
invasive, partially linked, developed, with sharp
edges and no internal features.

Interpretation: point used, boring

Comments: restriction of traces to tip, and the presence
of some of the same polish on the extreme tip when viewed
vertically confirm use

Ref: GM0930
Type:
Blank:
Mat: FLINT
Dim: 31X11X6
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: thick

Traces:

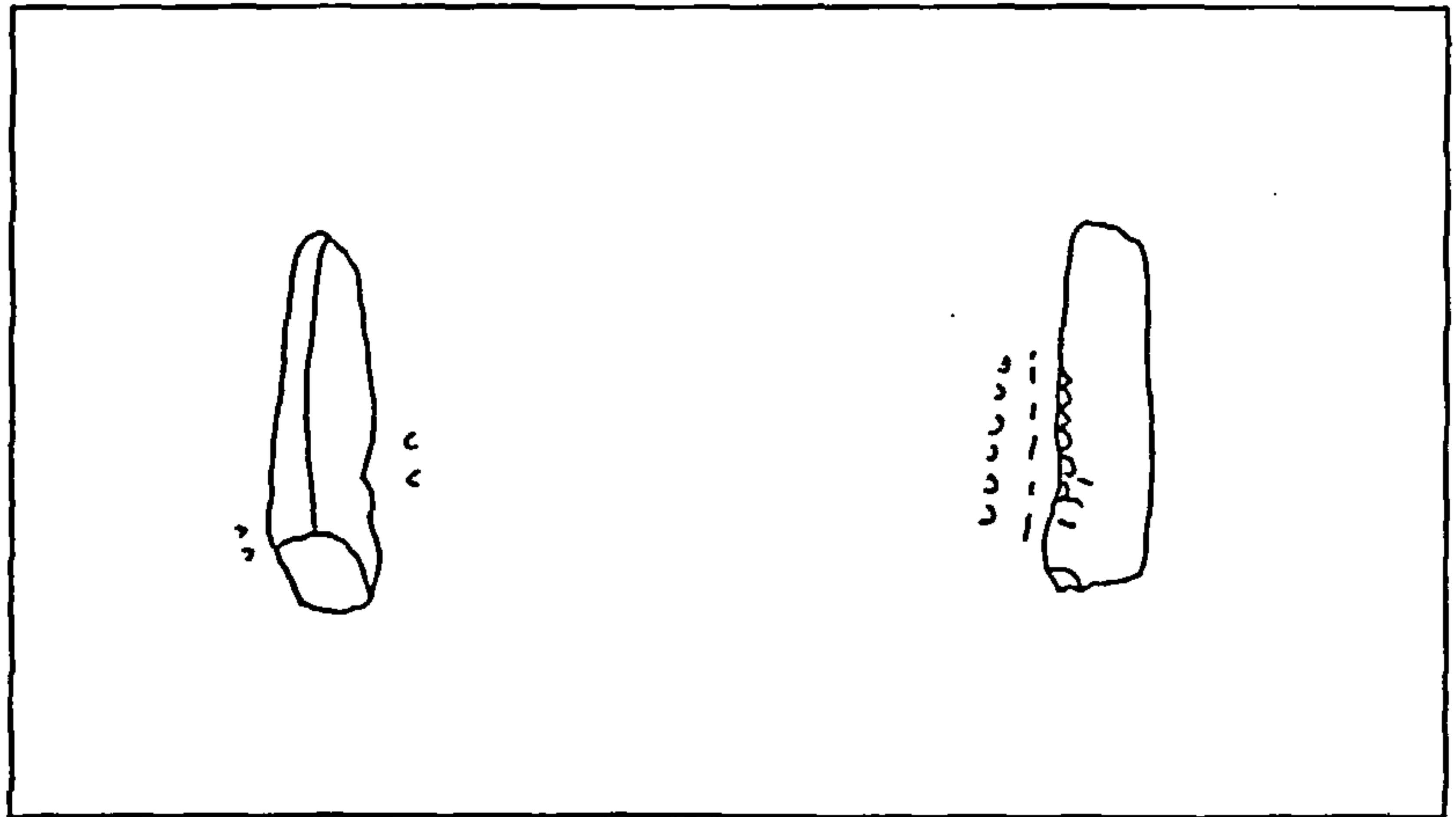
Dorsal side b: common clustered large to small mixed termination mixed scars, (at X regular minute edge row) associated with patchy polish on edge. Polish is smooth flat, partially linked, variable with gradual edges and no internal features. Associated with perpendicular short variable regular striations. Also with linear patches along ridges away from edge and on interior face. Polish is smooth domed, partially linked, poor, variable with soft edges and rare medium irregular pits.

Ventral side b: rare scattered small mixed terminating mixed scars.

Interpretation: side b used, probably transverse

Comments: rest of piece very fresh. Problem with polish and edge damage on the same side

Ref: GM0934
Type: MISC RET
Blank: BLADE
Mat: FLINT
Dim: 23x8x3
Qual: MED
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A

Edge Angle: acute

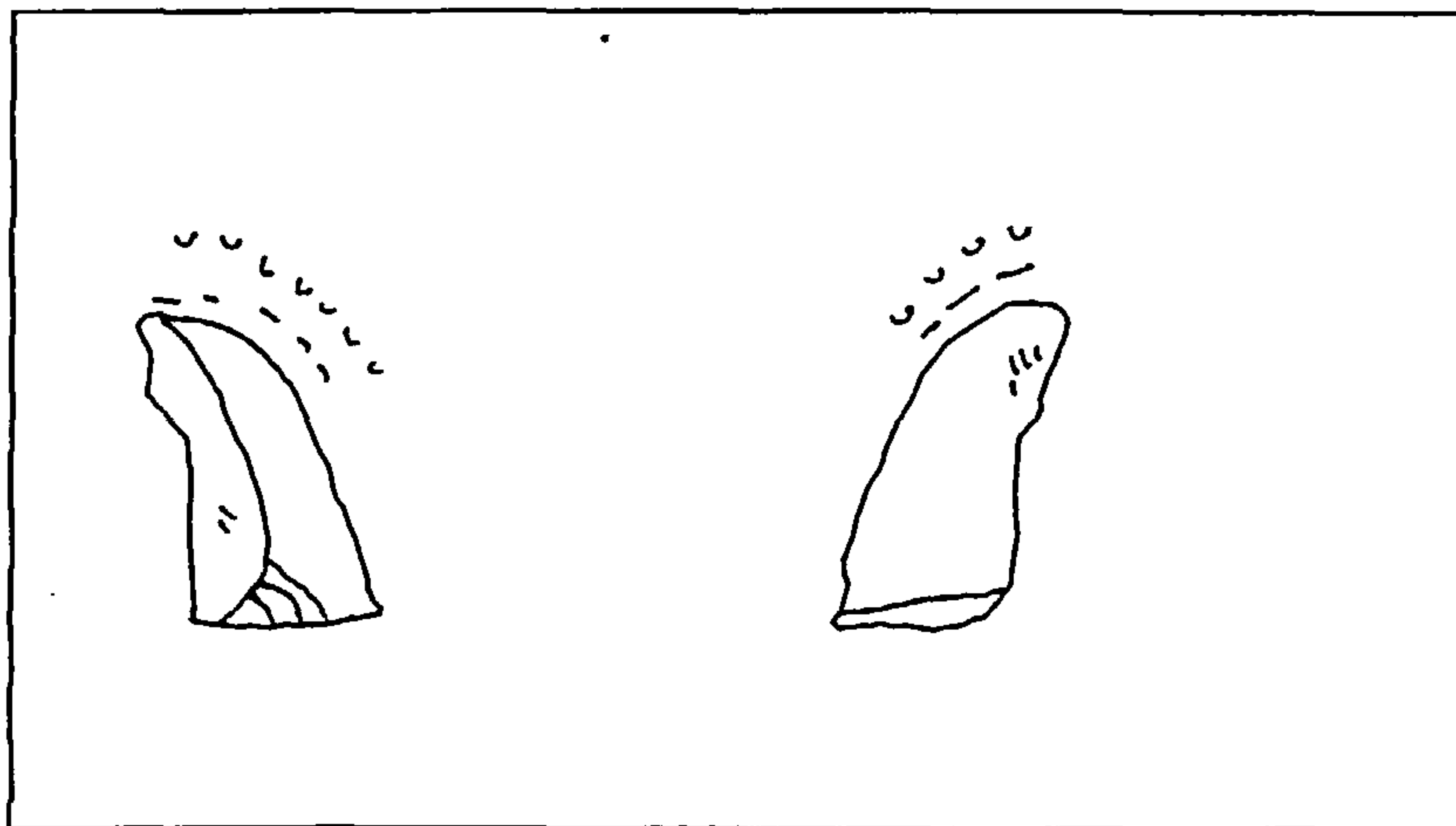
Traces:

Dorsal, side b: rare clustered small step
terminating deep scars

Ventral, side b: Common clustered large mostly
feather terminating deep scars, associated with a
restricted linear polish away from edge at 45o.
Polish is smooth flat, partially linked, with sharp
edges and no internal features. Also restricted
patchy polish on edge. Polish is smooth domed,
partially linked, with gradual edges and occasional
medium irregular pits.

Interpretation: side b used
Comments:

Ref: GM0937
Type: ED
Blank: FLAKE
Mat: FLINT
Dim: 15x15x4
Qual: MED
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures: F

Edge Angle: acute

Traces:

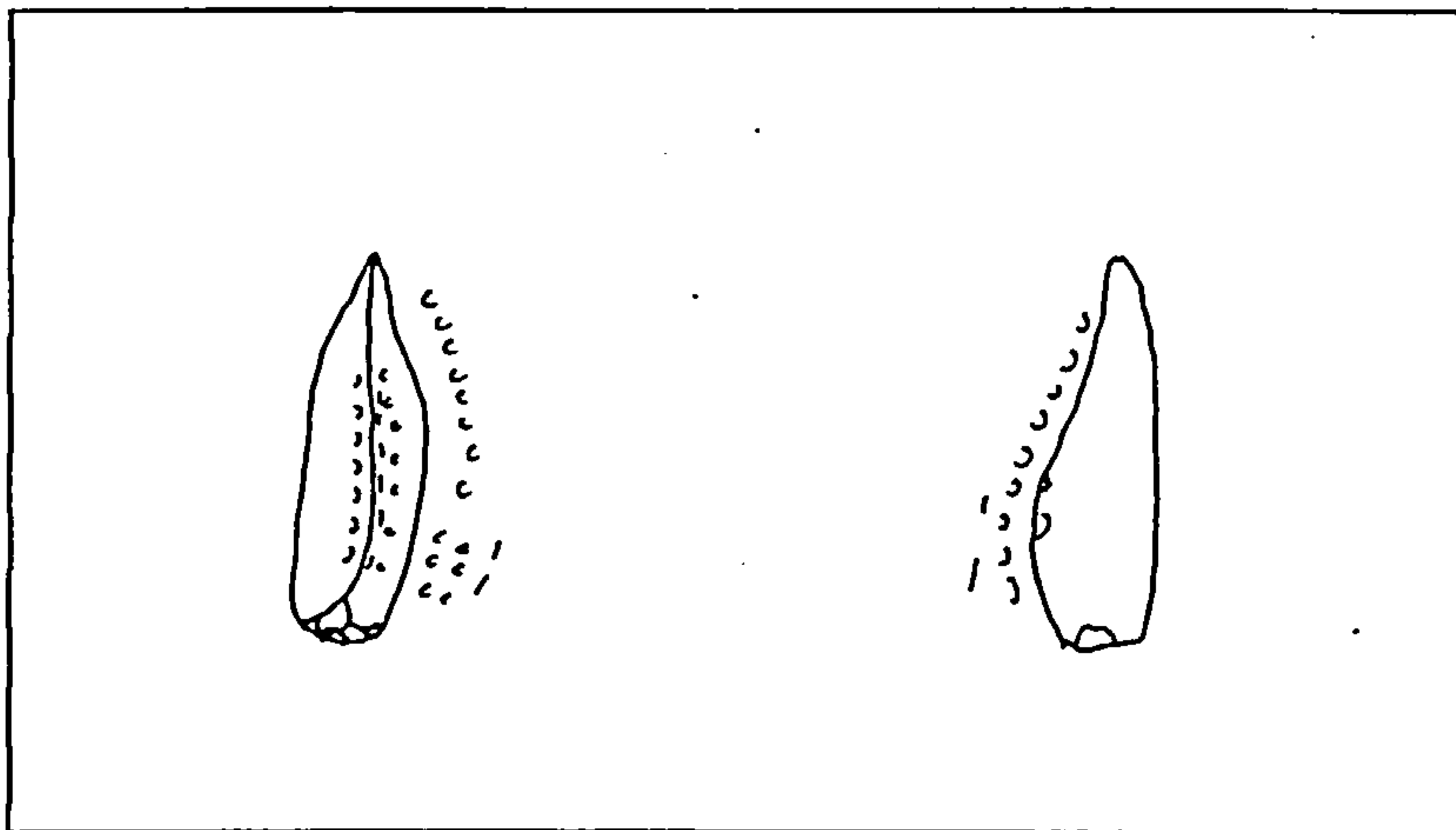
Side b, at distal end, both faces very similar: frequent clustered medium mixed termination mostly deep scars with snaps associated with A: patchy polish away from edge. Polish is smooth invasive/reticulated, scattered, variable, with sharp edges and occasional medium irregular pits. Also with B: restricted linear polish away from but parallel to edge. Polish is smooth domed, partially linked, developed, bright, with sharp edges and no internal features.

On interior face, both faces: Polish D: restricted narrow linear at 45o. Polish is smooth reticulated, scattered, developed, bright, with sharp edges and no internal features.

Interpretation: side b at distal used. Long motion, probably grooving, med hard material.

Comments:

Ref: GM0939
Type: ED
Blank: BLADE
Mat: FLINT
Dim: 21x7x3
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures: A

Edge Angle: thick

Traces:

Dorsal side b: numerous clustered and layered large to medium step terminating mostly deep scars.

Associated with A: restricted patchy polish away from edge. Polish is rough invasive, all over, developed, bright, variable, with gradual edges and frequent medium circular pits. Also with C:

restricted linear polish away from and at 75° to edge. Polish is rough reticulated scattered, poor, with gradual edges and occasional small circular pits.

Dorsal ridge (both aspects): frequent clustered medium to small step terminating mixed scars.

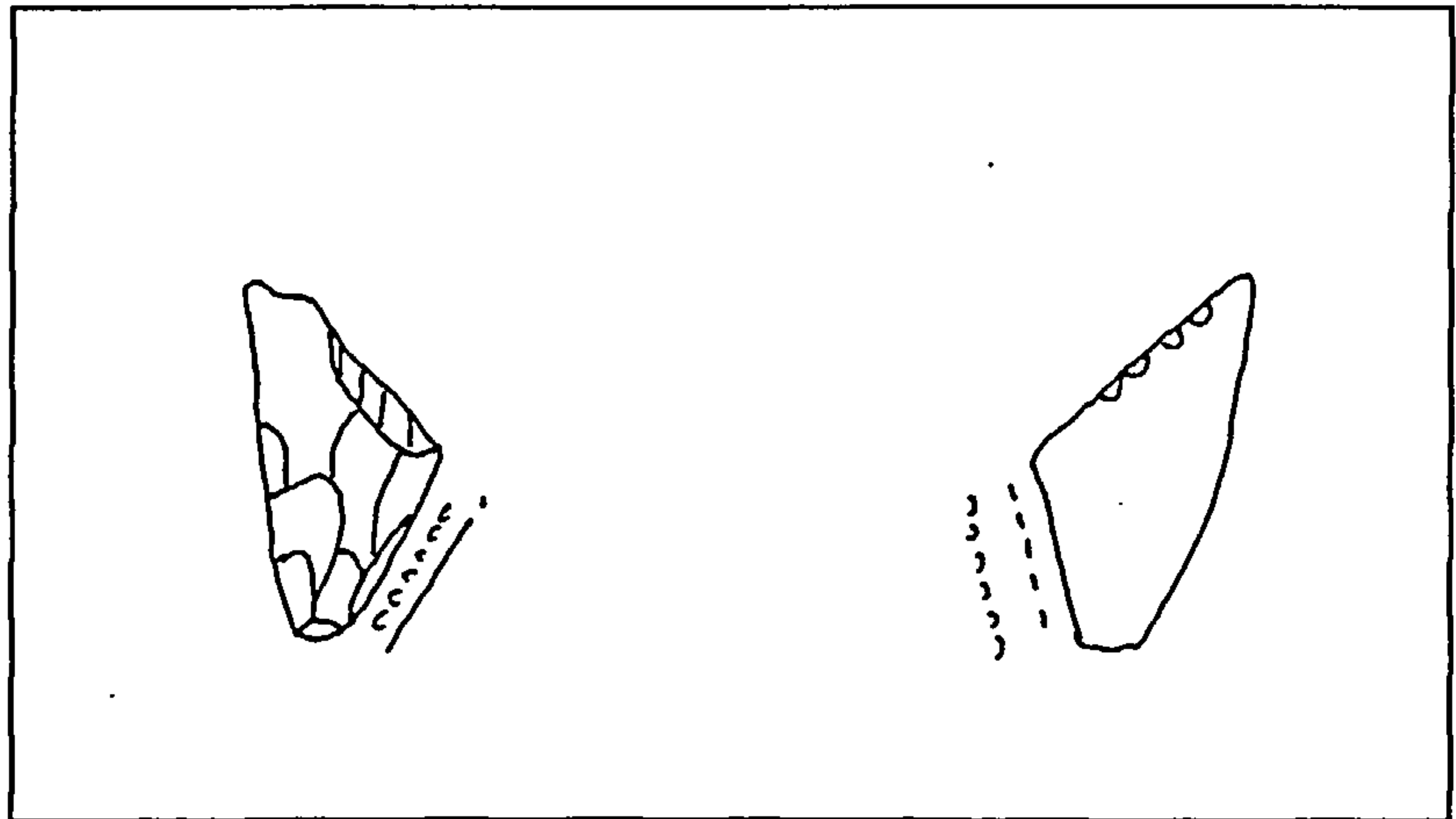
Associated with E: restricted linear polish along ridge edge. Polish is smooth flat all over, intense, bright, variable with abrupt edges and common medium irregular pits. Best developed on ridge side next to side b. Associated with perpendicular long medium broad striations.

Dorsal between ridge and edge, near distal: B: restricted linear polish away from and parallel to edge. Polish is smooth flat reticulated, partially linked, developed, with abrupt edges and occasional circular pits

Ventral side b: frequent clustered large to medium mostly step terminating mostly deep scars with snaps. Associated with patchy polish along and away from edge. Polish is smooth reticulated, scattered, variable, with sharp edges and no internal features.

Interpretation: used, prob side b, transverse
Comments: heavy use, difficult

Ref: GM0943
Type:
Blank: FLAKE
Mat: FLINT
Dim: 17x10x5
Qual: GOOD
Cond: SP



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A

Edge Angle: thick

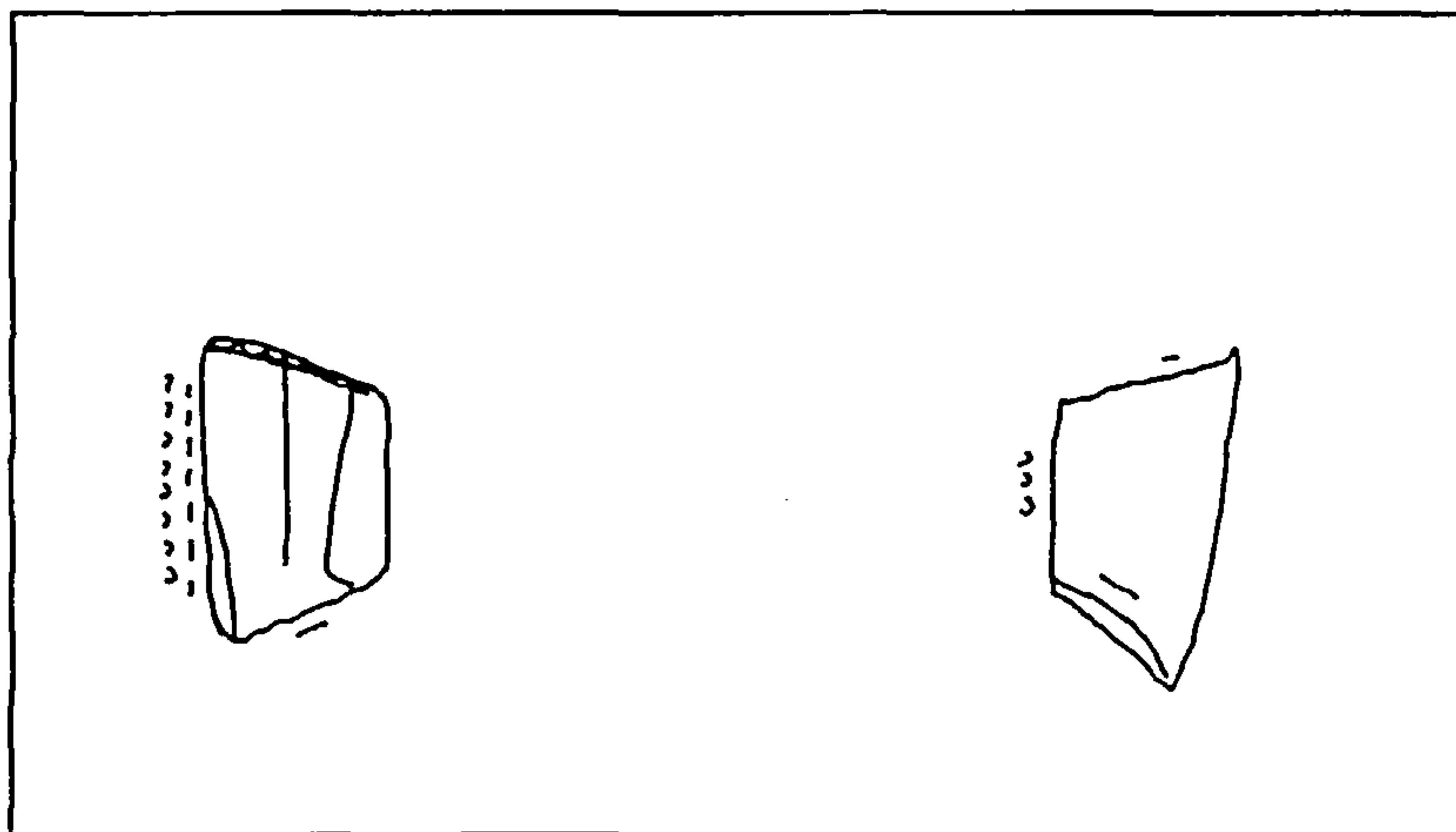
Traces:

Dorsal side b; common clustered small to minute mostly feather terminating deep scars with snaps, associated with a restricted narrow linear polish along the edge. Polish is smooth domed, all over, developed, with gradual edges and occasional medium irregular pits. Associated with parallel and perpendicular short medium fine cross striations.

Ventral side b: common clustered small to medium mostly feather terminating deep scars, associated with a patchy polish on the edge. Polish is smooth invasive, partially linked, variable with soft edges and common small irregular pits.

Interpretation: side b used, long motion
Comments:

Ref: GM0952
Type: TRUNC
Blank: FLAKE
Mat: FLINT
Dim: 23x13x3
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: medium

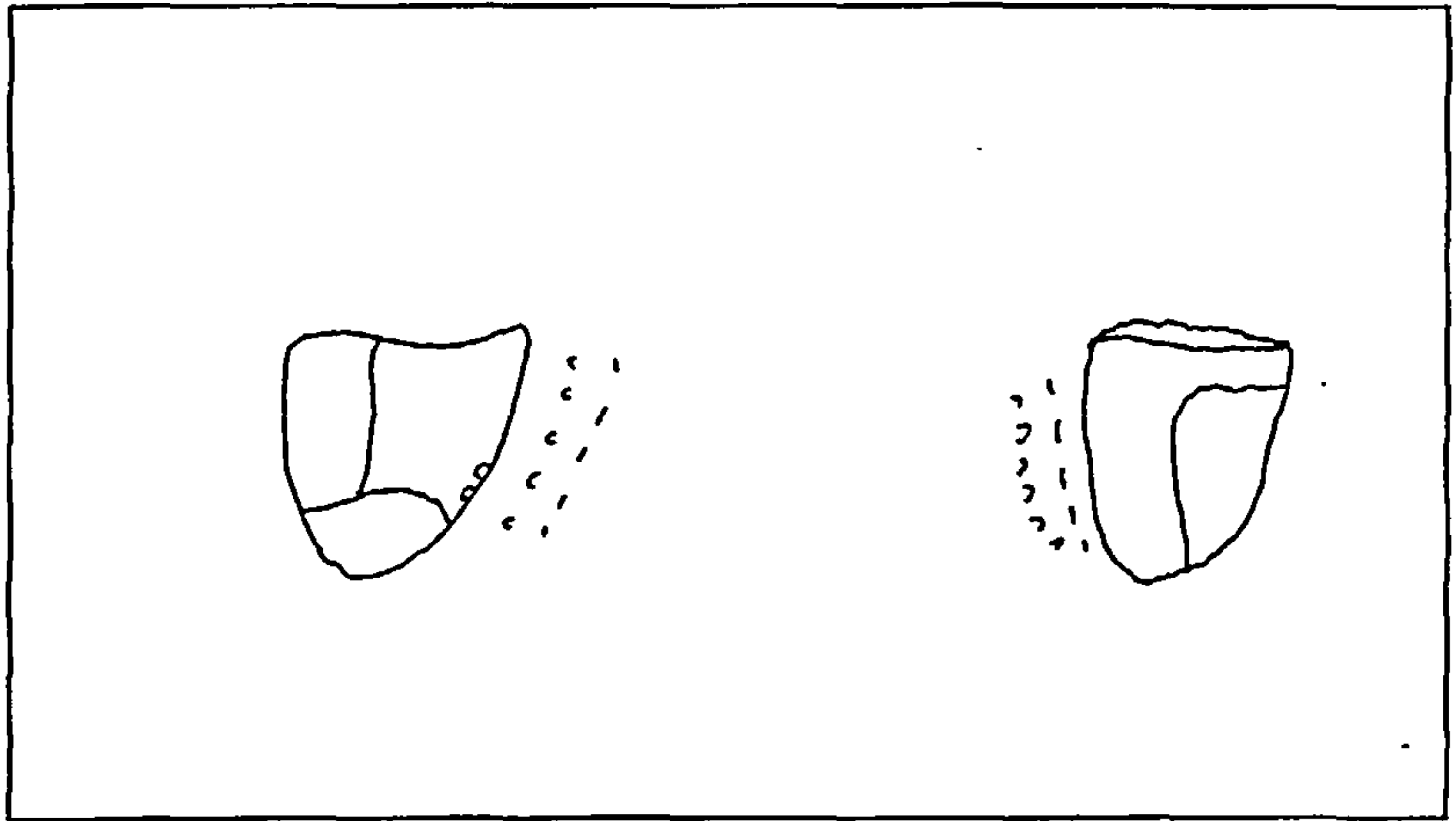
Traces:

Dorsal side a: frequent clustered medium to small mostly feather terminating deep scars, associated with a restricted narrow linear polish along the edge. Polish is smooth domed, allover, developed, bright, with abrupt edges and no internal features, also with a patchy spread of polish along the edge. Polish is smooth invasive, partially linked, poor, with soft edges and occasional small circular pits.

Ventral side a: occasional clustered medium to small mostly feather terminating deep scars, associated with a patchy spread along the edge. Polish is smooth invasive, partially linked, poor, with gradual edges and no internal features.

Interpretation: side a used, probably transverse
Comments:

Ref: GM0967
Type:
Blank: FLAKE
Mat: FLINT
Dim: 12x14x4
Qual: MED
Cond: PATINA



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A

Edge Angle: acute

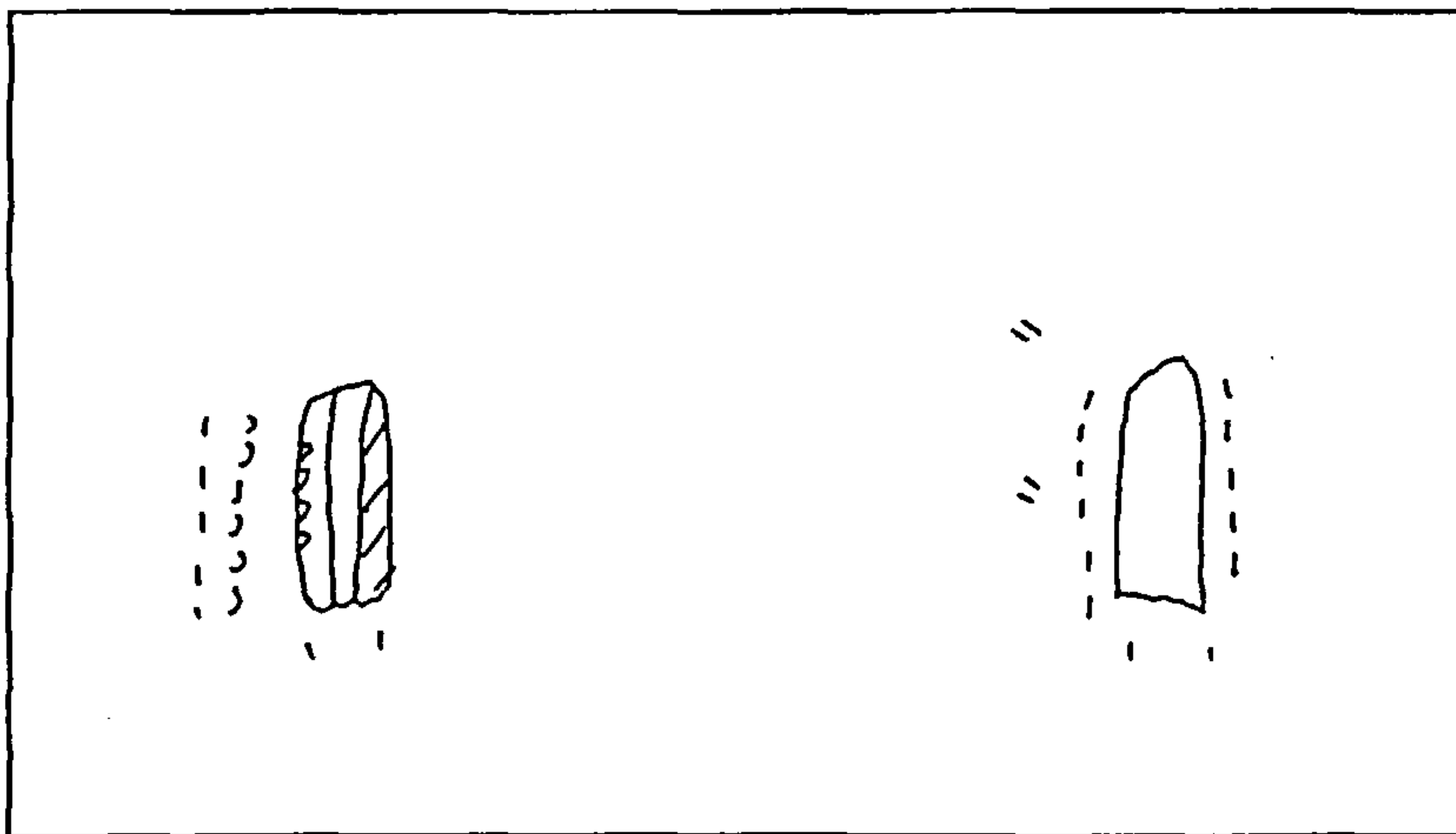
Traces:

Side b, both faces very similar: common clustered and layered medium to small mostly feather terminating mixed scars with some directional sense associated with restricted patches of polish away from edge. Polish is smooth flat (reticulated), partially linked, with abrupt edges and occasional medium irregular pits. Also, only on dorsal, restricted patches of polish on edge. Polish is smooth reticulated, partially linked, with sharp edges and occasional medium irregular pits.

Interpretation: side b used, longitudinal motion.

Comments: Differences put down to local microtopography

Ref: GM0982
Type: ED
Blank: CHUNK
Mat: FLINT
Dim: <10mm
Qual: MED
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: thick

Traces:

Dorsal side a: numerous clustered medium to small step terminating deep scars. Associated with patches of narrow linear polish along edge. Polish is rough reticulated, partially linked, poor, with gradual edges and no internal features.

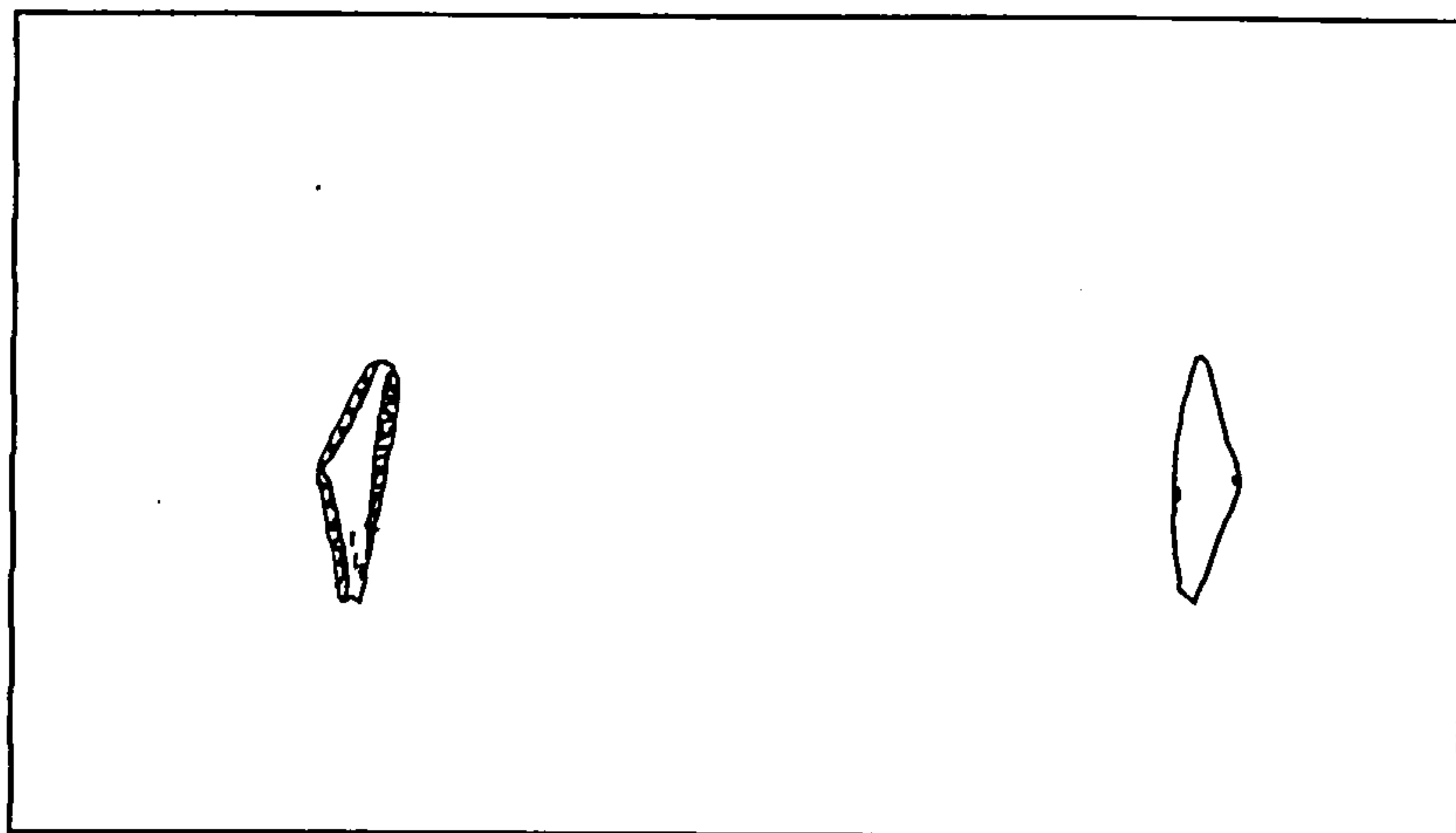
Ventral side a: No edge damage. Patchy polish along edge. Polish is smooth reticulated, partially linked, with gradual edges and no internal features.

Ventral side b: No edge damage. Patches of polish on edge. Polish is smooth invasive, partially linked, developed, with gradual edges and numerous small circular pits and common variable linear elements. Associated with 750 long deep broad random frequent striations.

Interpretation: Used, side b (side a hafting?), frag of a larger piece

Comments: piece hard to examine

Ref: GM1003
Type: MICRO
Blank: BLADE
Mat: FLINT
Dim: 11x4x1
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures: A

Edge Angle: thick

Traces:

Impossible to record edge damage because of retouch

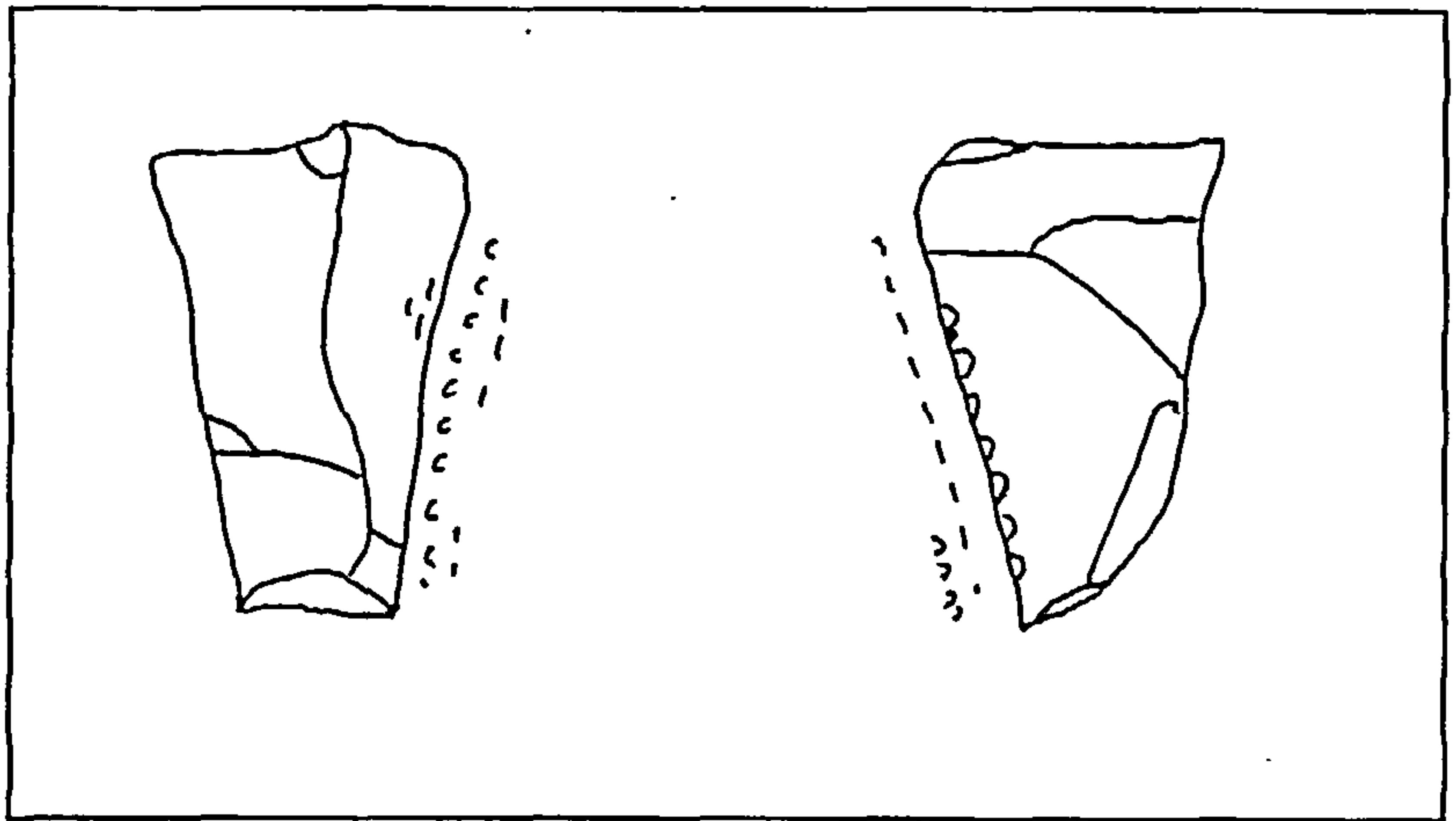
Polish A: Patchy narrow linear features parallel to long axis on interior face. Polish is rough reticulated, partially linked, poor, with sharp edges and no internal features.

Polish B: patchy polish on edge. Polish is rough invasive, partially linked, variable, with gradual edge and occasional small circular pits.

Interpretation: used, probably projectile

Comments: polish B may represent hafting

Ref: GM1117
Type: ED
Blank: FLAKE
Mat: FLINT
Dim: 42x32x10
Qual: MED
Cond: PATINA



Material: Grain: M Homog: V Crys: O Topo: F Fissures:
A

Edge Angle: thick

Traces:

Dorsal side b: frequent clustered small to minute mostly step terminating deep scars with snaps.

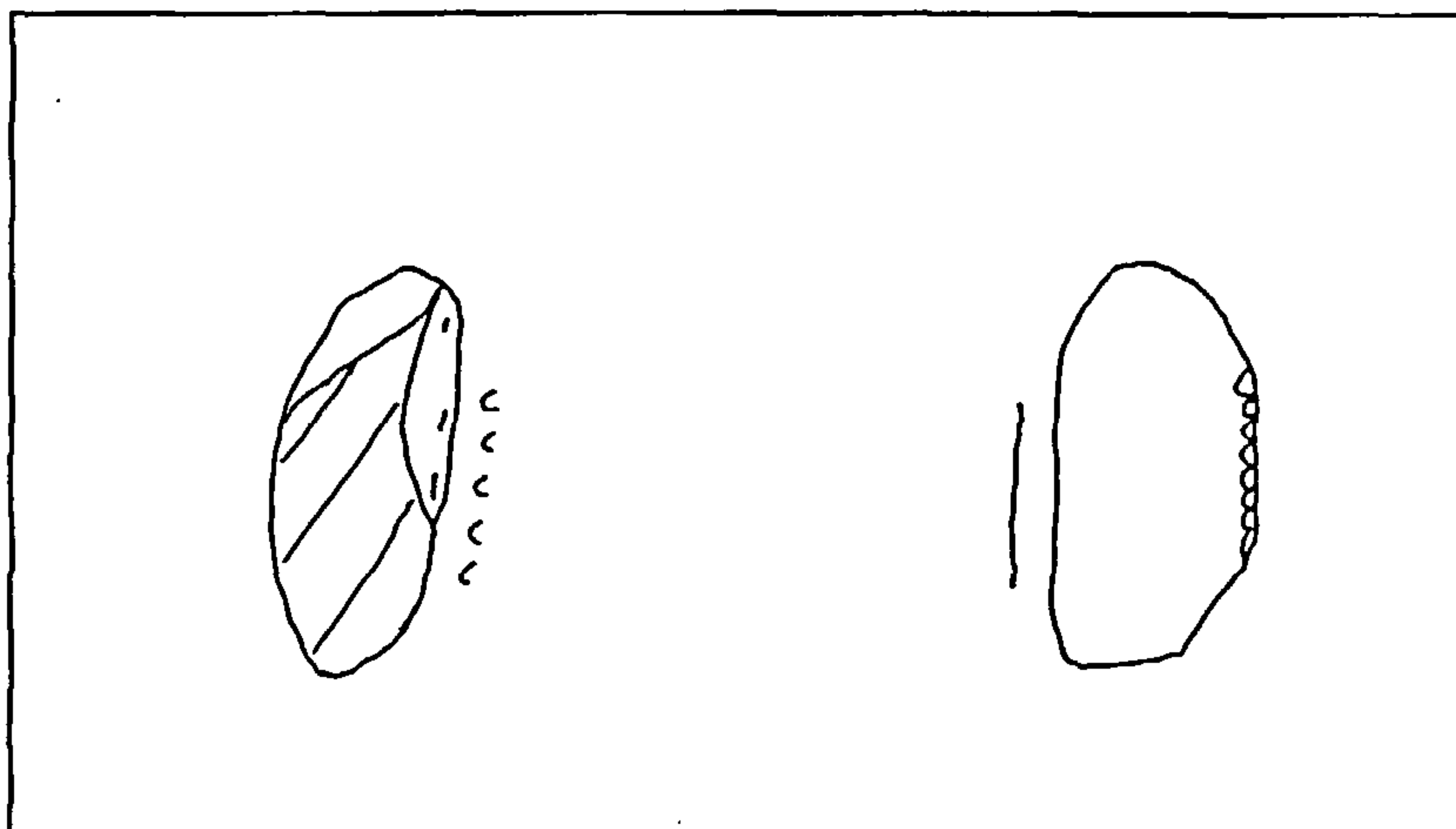
Associated with restricted patches of polish on edge. Polish is smooth flat reticulated, partially linked, developed, with sharp edges and common large irregular pits. Also restricted linear polish away from but parallel to edge. Polish is smooth reticulated, scattered, with sharp edges and no internal features.

Ventral side b: numerous clustered and layered large to medium mostly feather terminating deep scars. No associated polish

Interpretation: side b used, transverse motion, med hard material

Comments: some detail possibly obscured by developing patina

Ref: GM1146
Type: MISC RET
Blank: FLAKE
Mat: FLINT
Dim: 22x15x8
Qual: MED
Cond: FRESH



Material: Grain: M Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: thick

Traces:

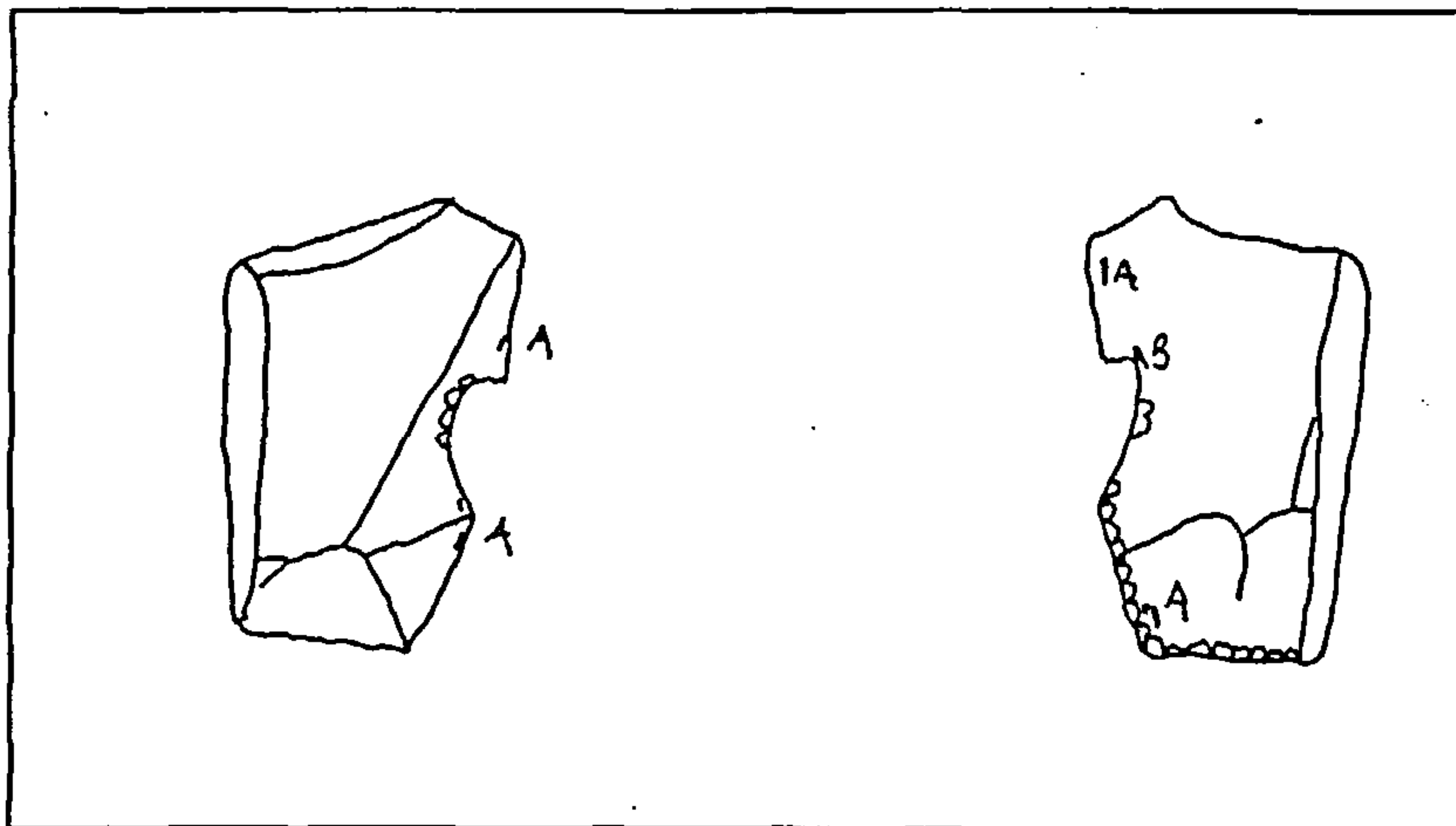
Dorsal side b: occasional clustered and layered medium step terminating deep scars. Associated with A: restricted patches on edge. Polish is smooth domed, partially linked, developed, bright, with gradual edges and no internal features. Also polish B: restricted patches away from edge. Polish is smooth flat, allover, developed, with gradual edges and common variable circular pits.

Ventral side b: no edge damage. Polish C: restricted patches away from edge. Polish is smooth flat, allover, developed, with sharp edges and numerous minute circular pits. Polish D: patchy polish along edge. Polish is smooth flat (reticulated), partially linked, with gradual edges and occasional small circular pits, also rare perpendicular linear elements.

Interpretation: side b used. transverse motion, med hard material

Comments:

Ref: GM1158
Type: NOTCH
Blank: FLAKE
Mat: FLINT
Dim: 35x23x17
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: thick

Traces:

No discernible edge damage

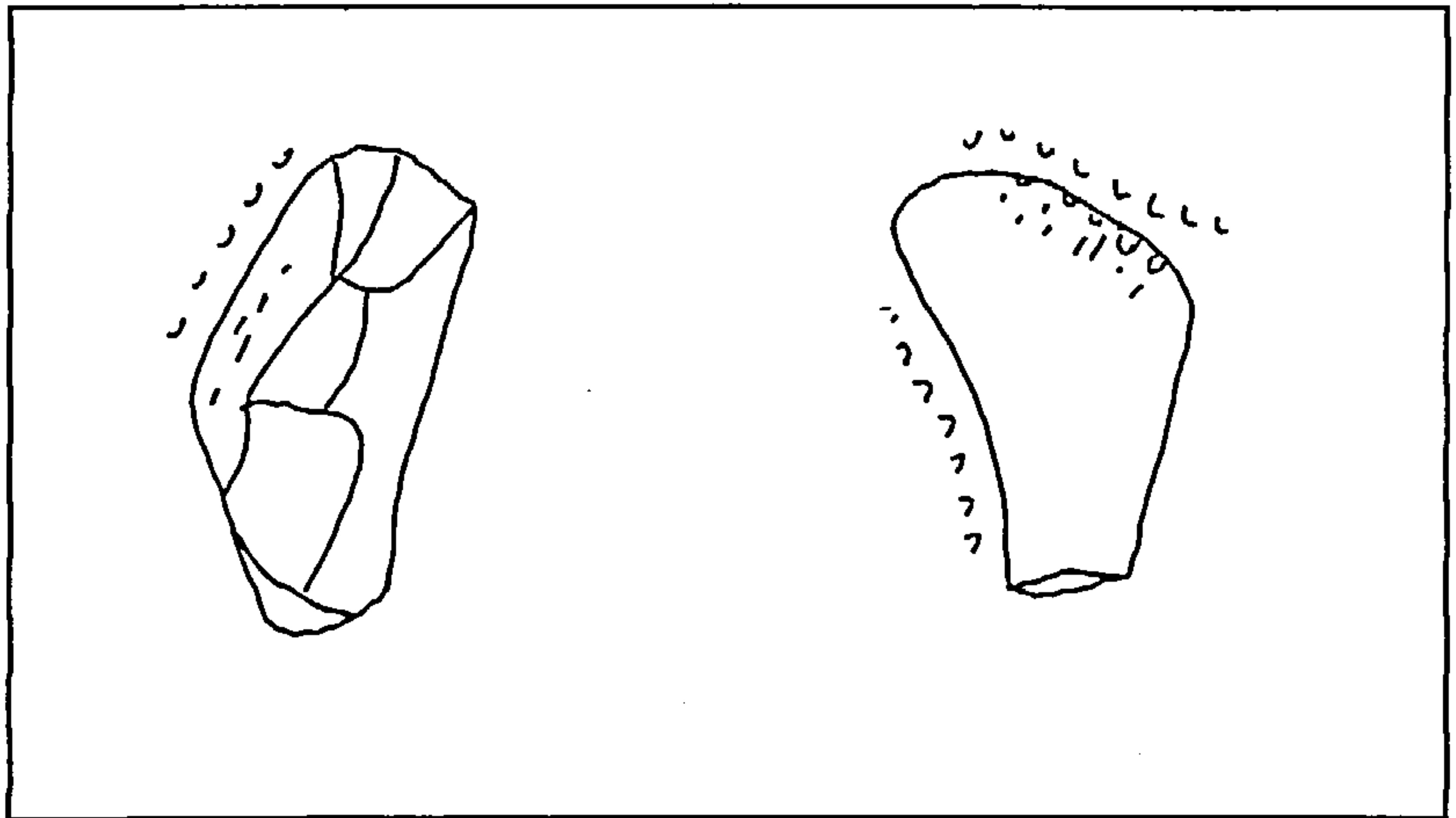
Polish A: Broad patchy spread along and away from edge. Polish is smooth flat, partially linked, developed, with sharp edges and frequent irregular pits.

Polish B: patchy polish along and away from edge. Polish is smooth invasive, partially linked, with gradual edges and occasional small irregular pits

Interpretation: side b used

Comments: Polish B pos techno, part of notch manufacture, polish A appears to pre-date notch

Ref: GM1163
Type: ED
Blank: FLAKE
Mat: FLINT
Dim: 27x24x4
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures: A

Edge Angle: medium

Traces:

Dorsal side a: occasional clustered medium mostly step terminating mostly deep scars associated with a restricted linear polish away from but parallel to the edge. Polish is rough reticulated, partially linked, developed, bright, with abrupt edges and no internal features.

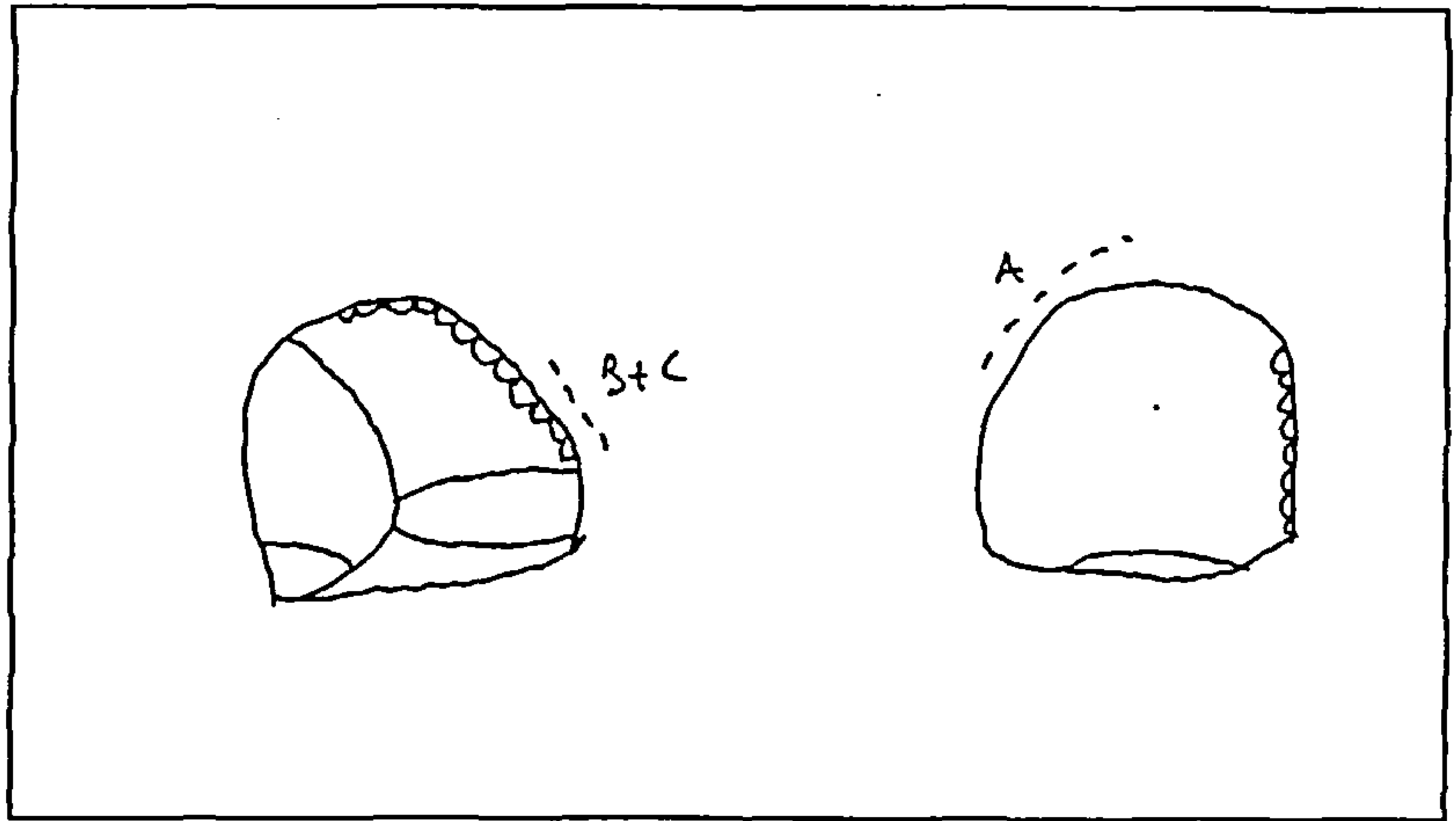
Dorsal side b: No edge damage. Restricted narrow linear polish along the edge. Polish is smooth invasive, partially linked, variable with gradual edges and no internal features.

Ventral side a: frequent clustered medium to small mostly step terminating mostly deep scars with snaps. Associated with a restricted linear polish away from and perpendicular to the edge. Polish is smooth flat (reticulated), partially linked, developed, with abrupt edges and occasional small irregular pits.

Ventral side b: common clustered minute step terminating deep scars. No associated polish

Interpretation: sides a and b used. B = transverse
Comments: difficult, especially side a. Appears to be two different uses

Ref: GM1211
Type: MISC RET
Blank: FLAKE
Mat: FLINT
Dim: 22x30x10
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures: A

Edge Angle: thick

Traces:

Edge damage not possible due to retouch.

Polish A: Restricted narrow linear polish along edge. Polish is smooth domed, allover, with sharp edges and occasional variable irregular pits.

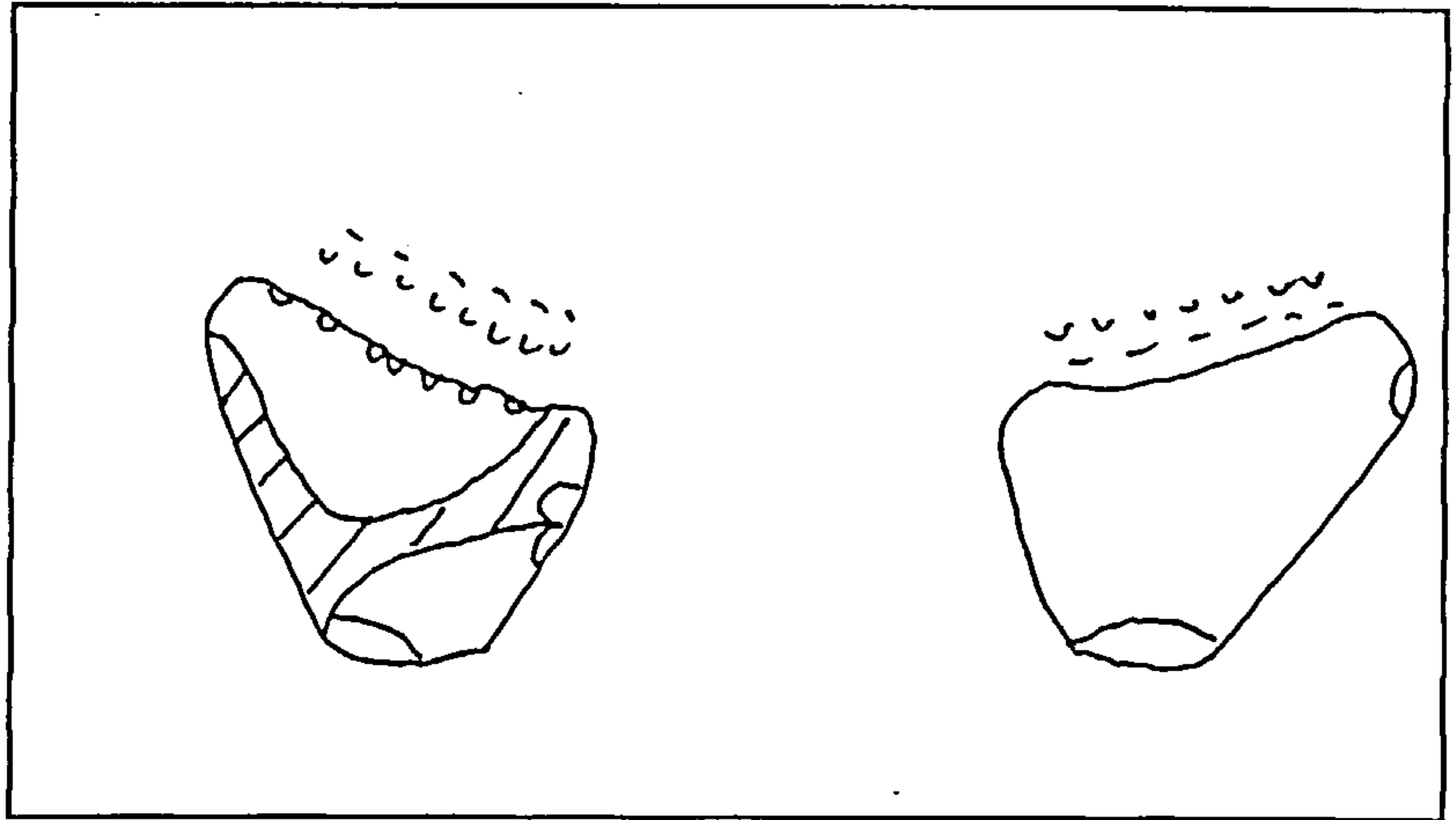
Polish B: patchy away from edge. Polish is rough reticulated, partially linked, with gradual edges and no internal features.

Polish C: patchy away from edge (some linearity on ridges). Polish is smooth domed invasive, partially linked, with gradual edges and occasional small irregular pits.

Interpretation: distal end used, transverse motion

Comments: Polish almost certainly techno. Polish A most definitely use

Ref: GM1218
Type: ED
Blank: FLAKE
Mat: FLINT
Dim: 31x42x10
Qual: MED
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
O

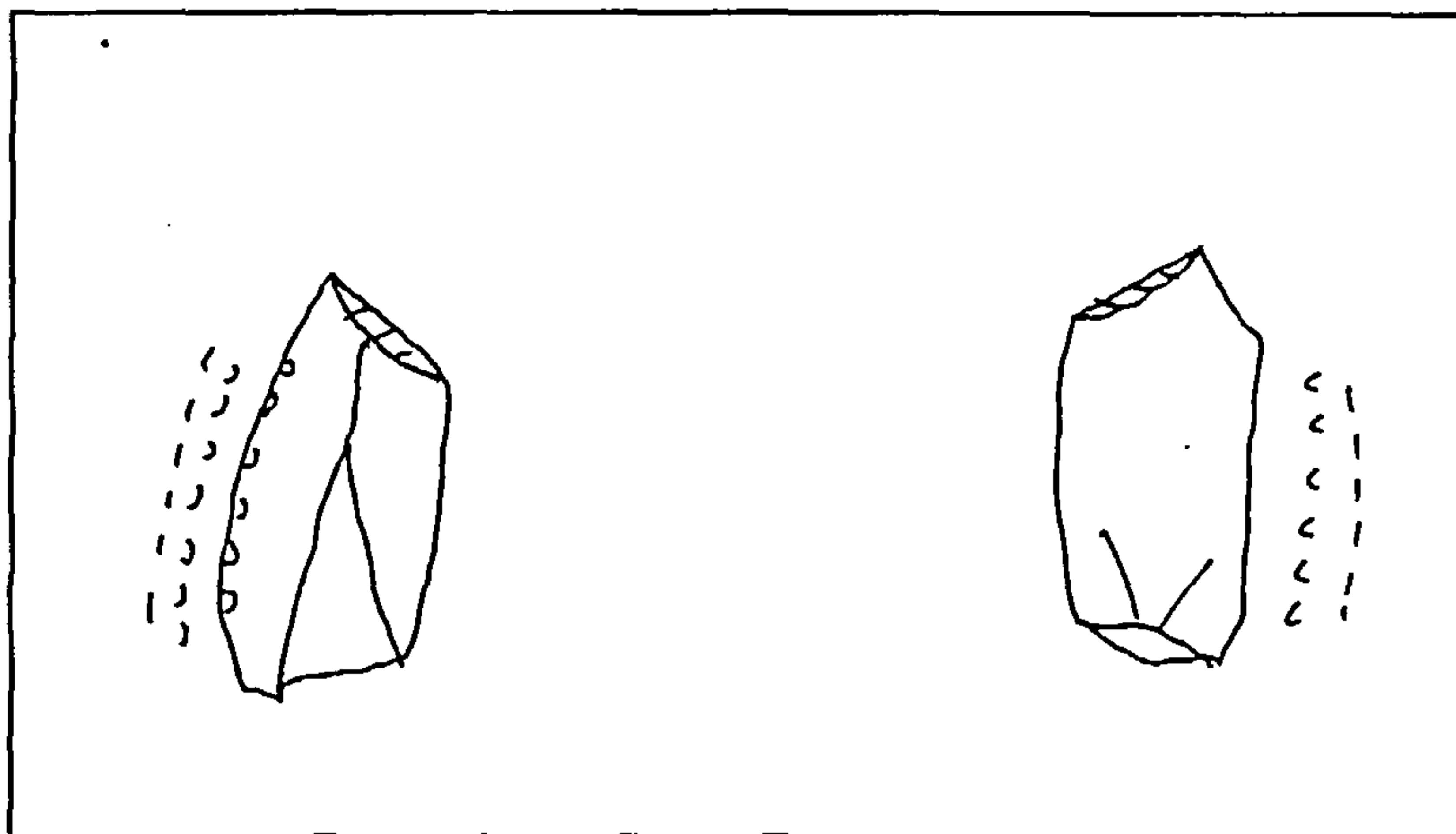
Edge Angle: acute

Traces:

Distal end, edge damage on both faces the same:
numerous clustered medium mixed termination mostly
deep scars. Associated with: Polish A (ventral
face): patchy linear polish along edge. Polish is
smooth domed, partially linked, developed, with
gradual edges and no internal features. Forms edge
bevel. And with Polish B (dorsal face): patchy
polish away from edge. Polish is smooth reticulated,
partially linked, with soft edges and no internal
features.

Interpretation: distal end used, long motion
Comments: saw like appearance of traces.

Ref: GM1289
Type: ED
Blank: FLAKE
Mat: FLINT
Dim: 23x15x5
Qual: MED
Cond: PATINA



Material: Grain: M Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: acute

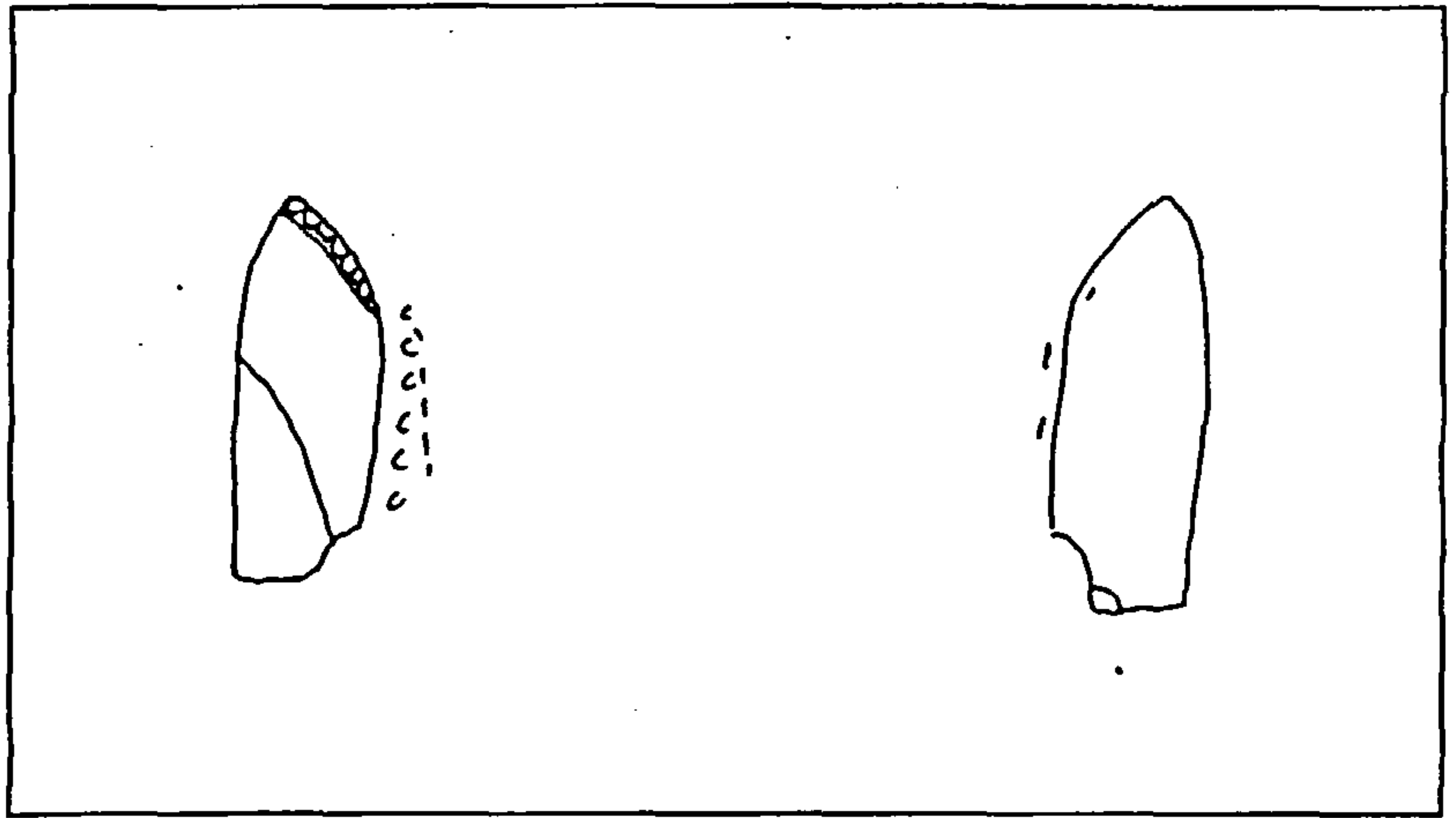
Traces:

Side a, both faces nearly identical, slightly less edge damage on ventral: regular clustered minute mostly feather terminating mostly deep scars with snaps. Associated with patchy polish along edge. Polish is smooth domed, partially linked, with soft edges and occasional small irregular pits

Interpretation: side a used, long motion

Comments: developing patina causes problems

Ref: GM1318
Type: TRUNC
Blank: BLADE
Mat: FLINT
Dim: 25x12x3
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A

Edge Angle: medium

Traces:

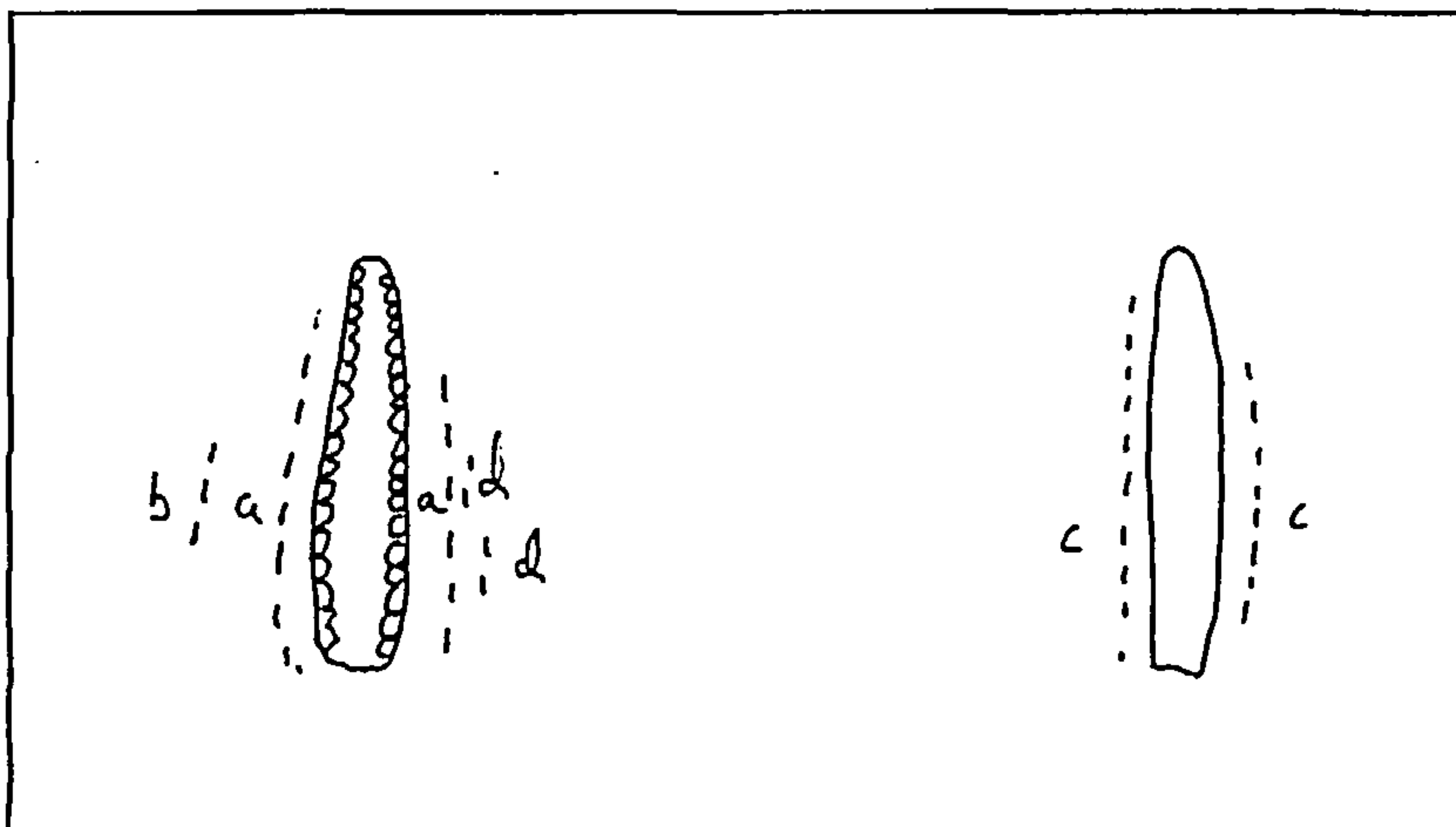
Dorsal side b; common clustered small mostly step terminating mostly deep scars. Associated with restricted patchy polish away from edge. Polish is smooth flat all over, developed, bright, with sharp edges and common small irregular pits.

Ventral side b: no edge damage. restricted patchy polish on edge. Polish is smooth reticulated, bright, with gradual edges and common large irregular pits.

Interpretation: side b used, transverse motion

Comments: poor traces, polishes very limited in area.

Ref: GM1335
Type: MICRO
Blank: BLADE
Mat: FLINT
Dim: 18x3x2
Qual: EXC
Cond: PATINA



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: thick

Traces:

edge damage not recorded because of retouch

Polish A: restricted narrow linear polish along edge. Polish is smooth domed, partially linked, developed, bright, with sharp edges and no internal features.

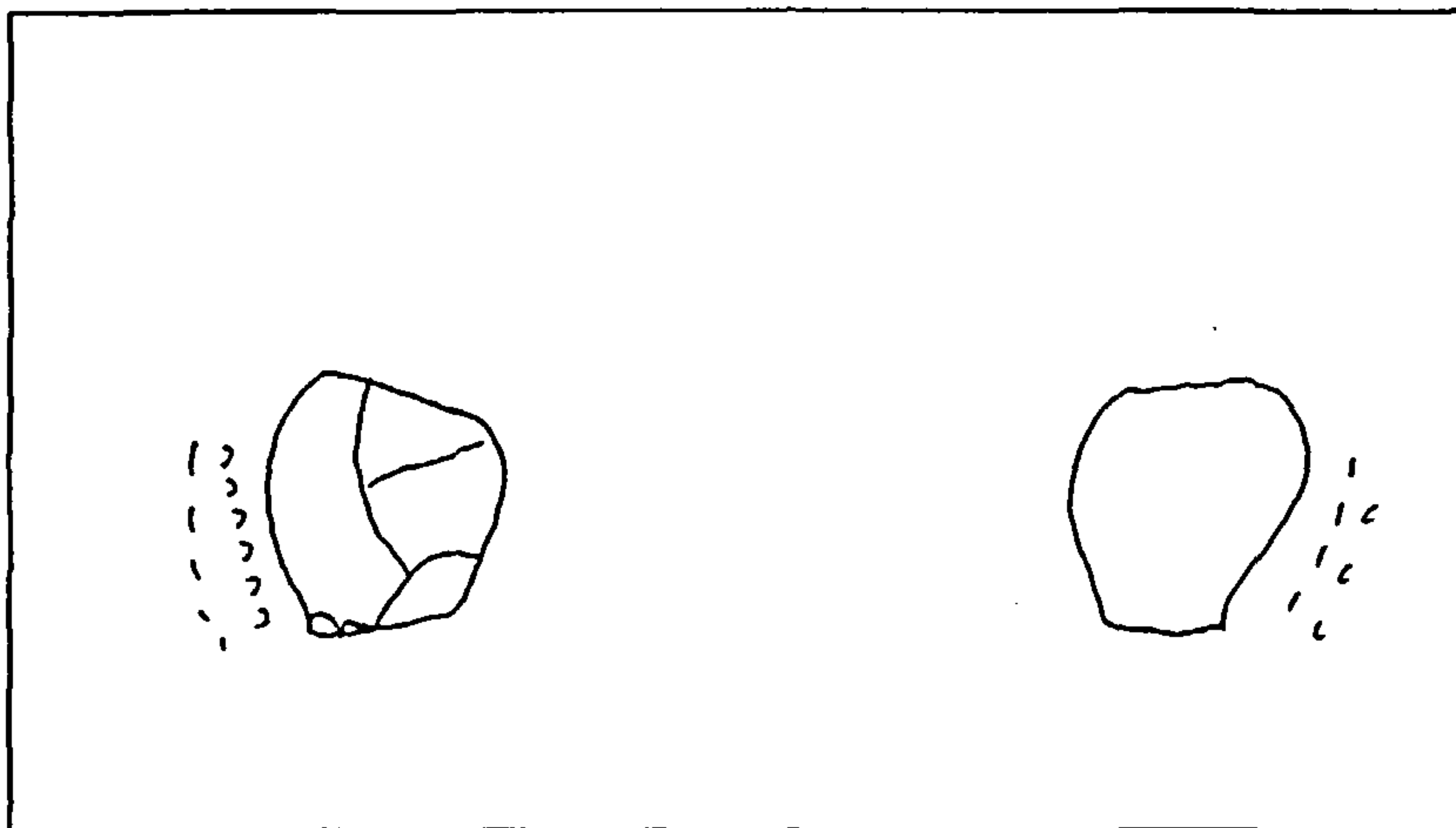
Polish B: Restricted narrow linear polish away from edge. Polish is smooth invasive, partially linked, with gradual edges and no internal features.

Polish C: Restricted linear polish along edge. Polish is extremely variable.

Polish D: Restricted spread along edge. Polish is smooth domed, all over, developed, bright, with gradual edges and occasional variable circular pits.

Interpretation: used
Comments: complex

Ref: GM1388
Type:
Blank: FLAKE
Mat: FLINT
Dim: 17x15x4
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: acute

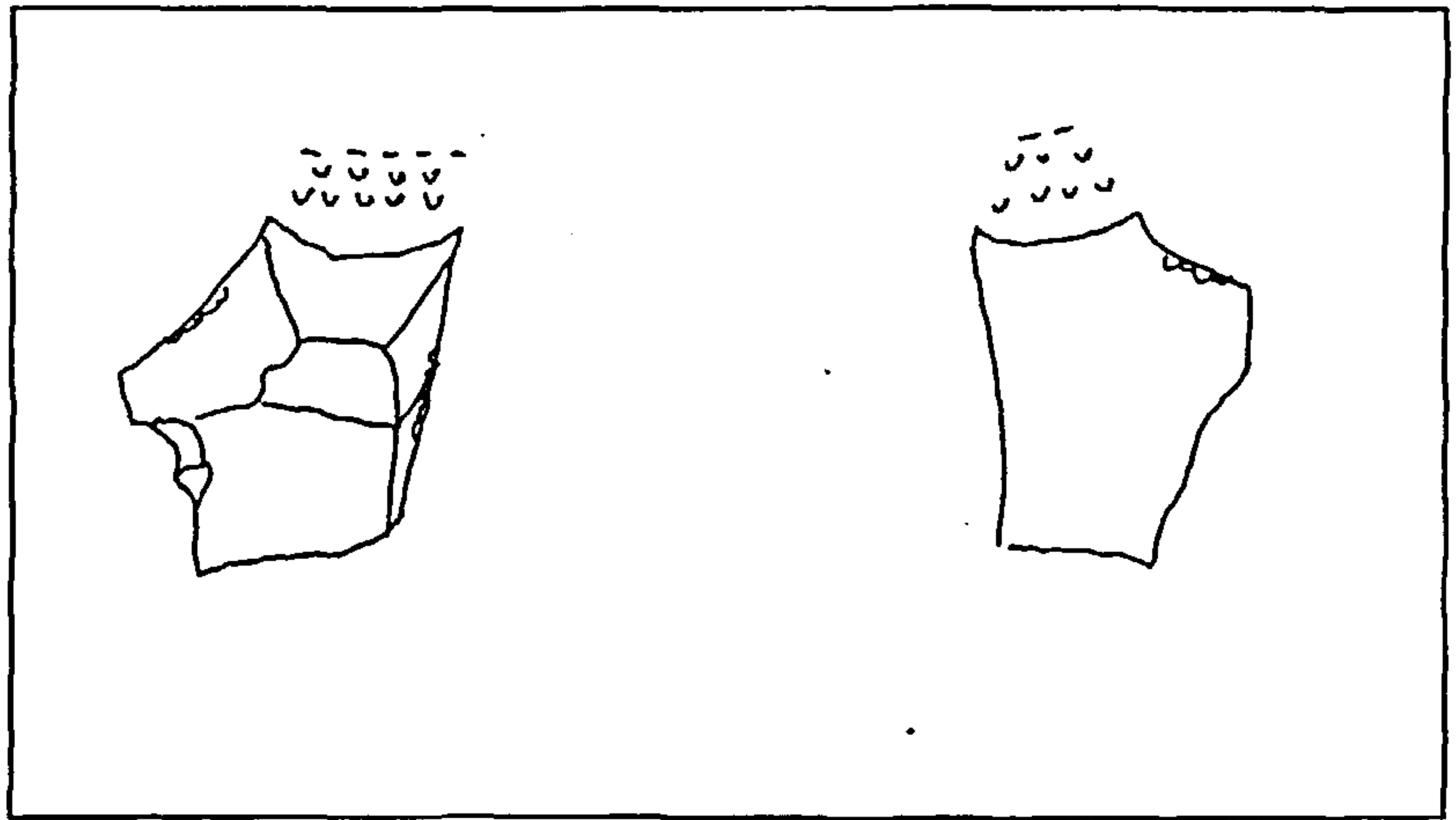
Traces:

Dorsal side a: occasional clustered small mostly step terminating mostly shallow scars with snaps. Associated with a patchy narrow linear polish along the edge. Polish is smooth invasive, partially linked, poor with gradual edges and no internal features.

Ventral side a: rare clustered small to minute mostly step terminating mostly deep scars with snaps, associated with restricted patches away from the edge. Polish is smooth invasive, scattered, poor, with gradual edges and no internal features.

Interpretation: side a used, long motion, soft material
Comments: minimal wear traces, but well patterned

Ref: GM1393
Type: ED
Blank: FLAKE
Mat: FLINT
Dim: 24x25x6
Qual: POOR
Cond: BURNT



Material: Grain: M Homog: V Crys: A Topo: F Fissures:
A

Edge Angle: thick

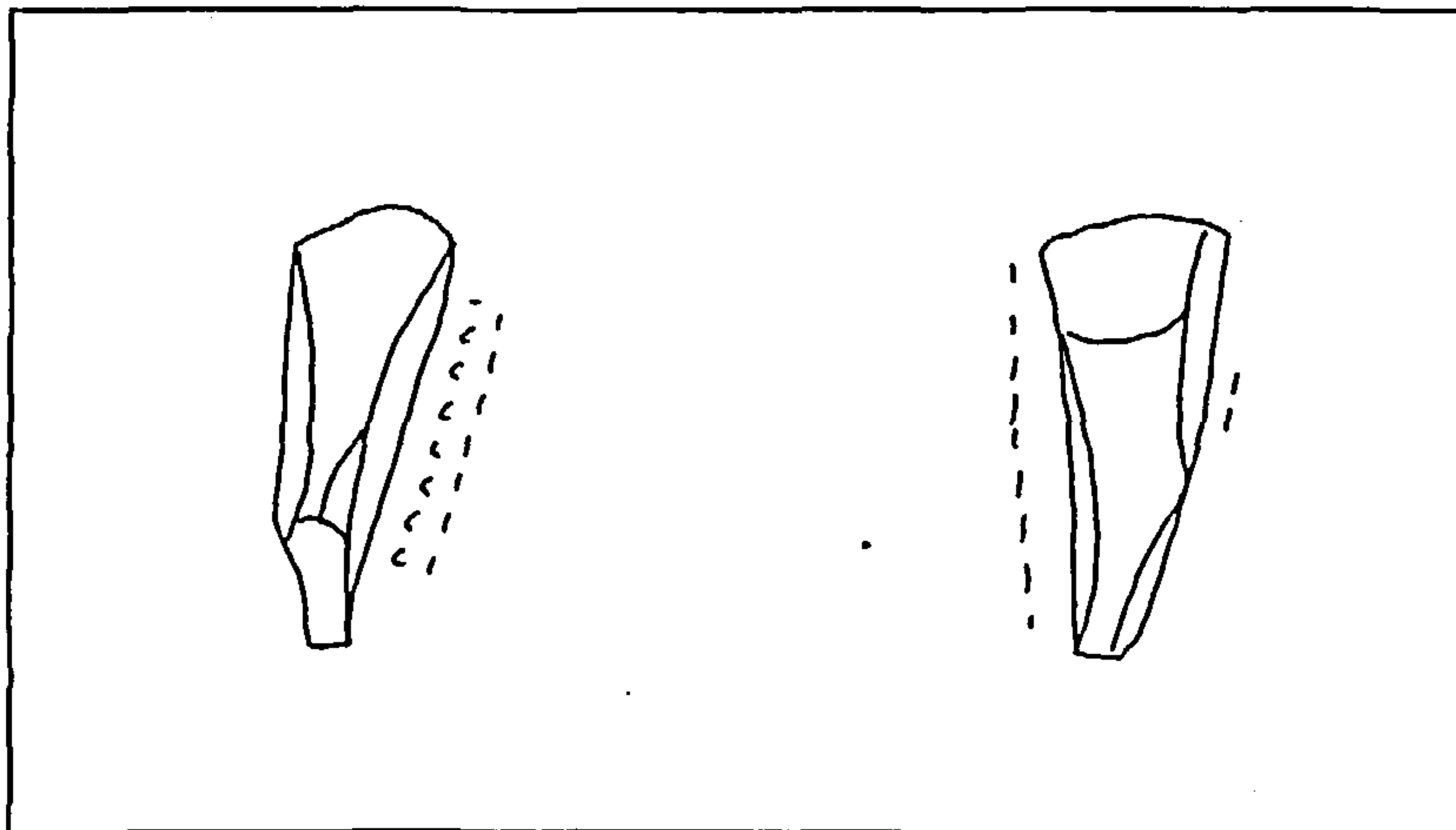
Traces:

Distal end, both faces very similar: common clustered and layered large to small mostly feather terminating deep scars associated with patchy polish away from edge. Polish is smooth flat reticulated, partially linked, developed, bright, with abrupt edges and occasional large irregular pits. Also with restricted patches on edge. Polish is rough invasive, partially linked, with gradual edges and common medium irregular pits.

Interpretation: distal end used, long motion

Comments: burning does not seem to cause too many problems here

Ref: GM1395
Type:
Blank: BLADE
Mat: FLINT
Dim: 31x11x7
Qual: GOOD
Cond: SP



Material: Grain: F Homog: H Crys: A Topo: F Fissures: A

Edge Angle: thick

Traces:

Dorsal side b: frequent clustered and layered small to minute mostly feather terminating shallow scars, associated with patchy linear polish along the edge. Polish is smooth domed, partially linked, with gradual edges and no internal features.

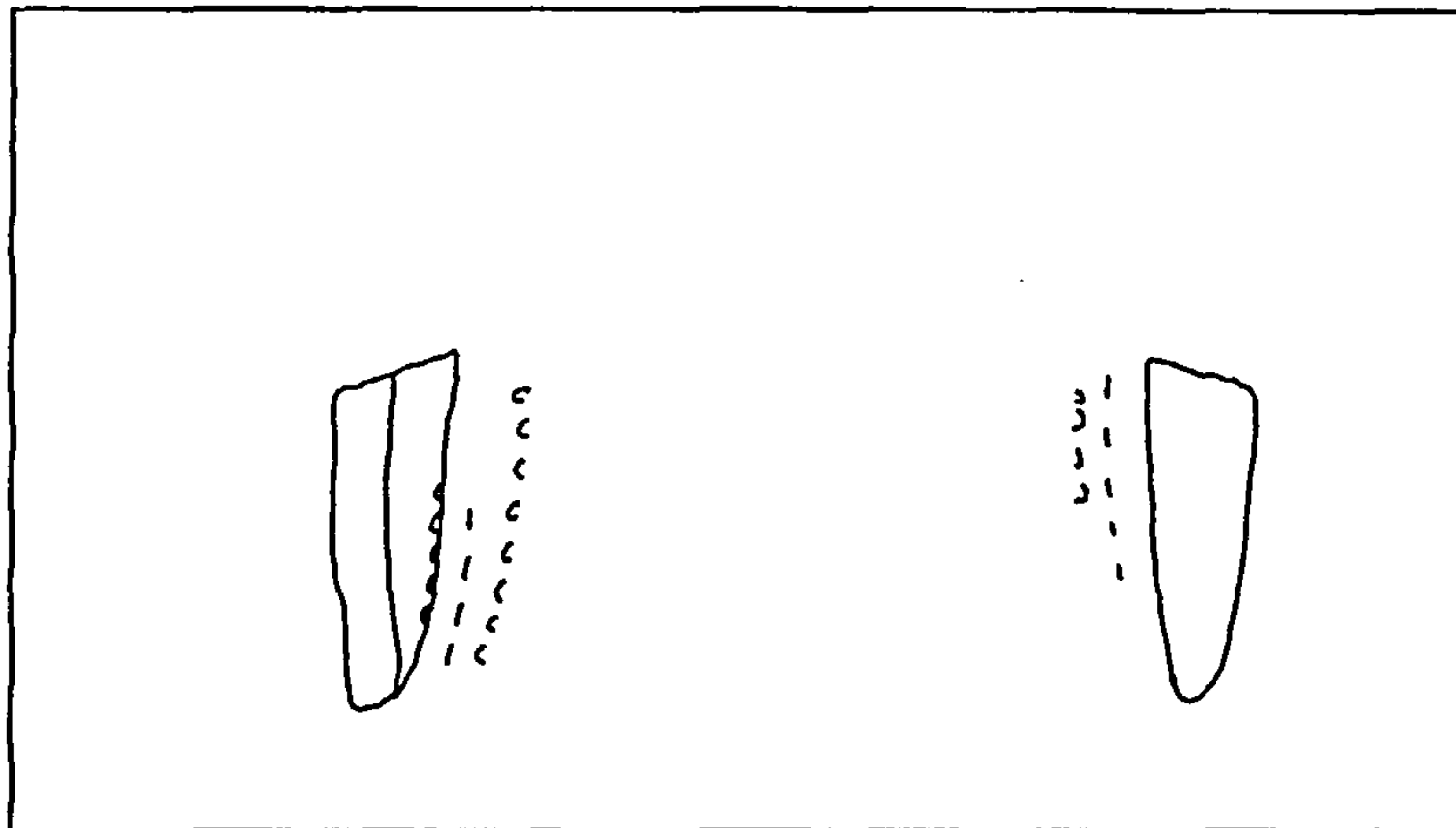
Ventral side b: no edge damage. Polish as on dorsal, but very restricted and narrow along extreme edge.

Side a: restricted polish along edge. Polish is smooth domed, with sharp edges and no internal features, very limited in extent.

Interpretation: side b used, transverse, soft material, ventral lead

Comments: polish b probably hafting/prehension thick

Ref: GM1396
Type: ED
Blank: BLADE
Mat: FLINT
Dim: 19x7x2
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
C

Edge Angle: acute

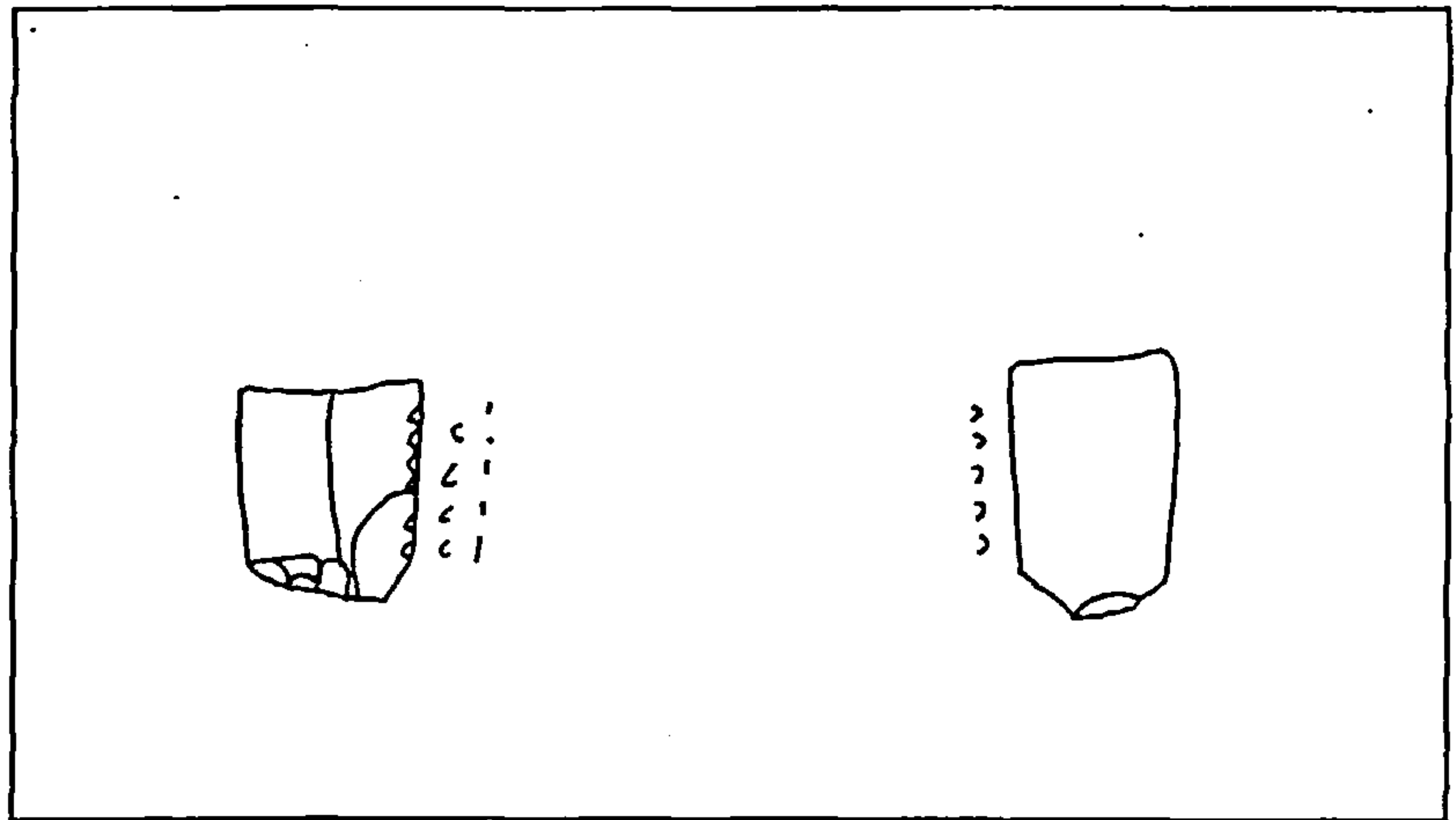
Traces:

Dorsal side b: numerous clustered small mixed terminating deep scars, associated with a restricted narrow linear polish along the edge. Polish is smooth invasive, partially linked, developed, with sharp edges and no internal features. Forms edge bevel.

Ventral side b: Numerous clustered medium mostly feather terminating deep scars. Associated with polish as on dorsal.

Interpretation: side b used, long motion, soft material
Comments: polish better on ventral, edge damage on dorsal

Ref: GM1419
Type: ED
Blank: FLAKE
Mat: FLINT
Dim: 11x9x3
Qual: GOOD
Cond: PATINA



Material: Grain: F Homog: H Crys: A Topo: F Fissures: A

Edge Angle: medium

Traces:

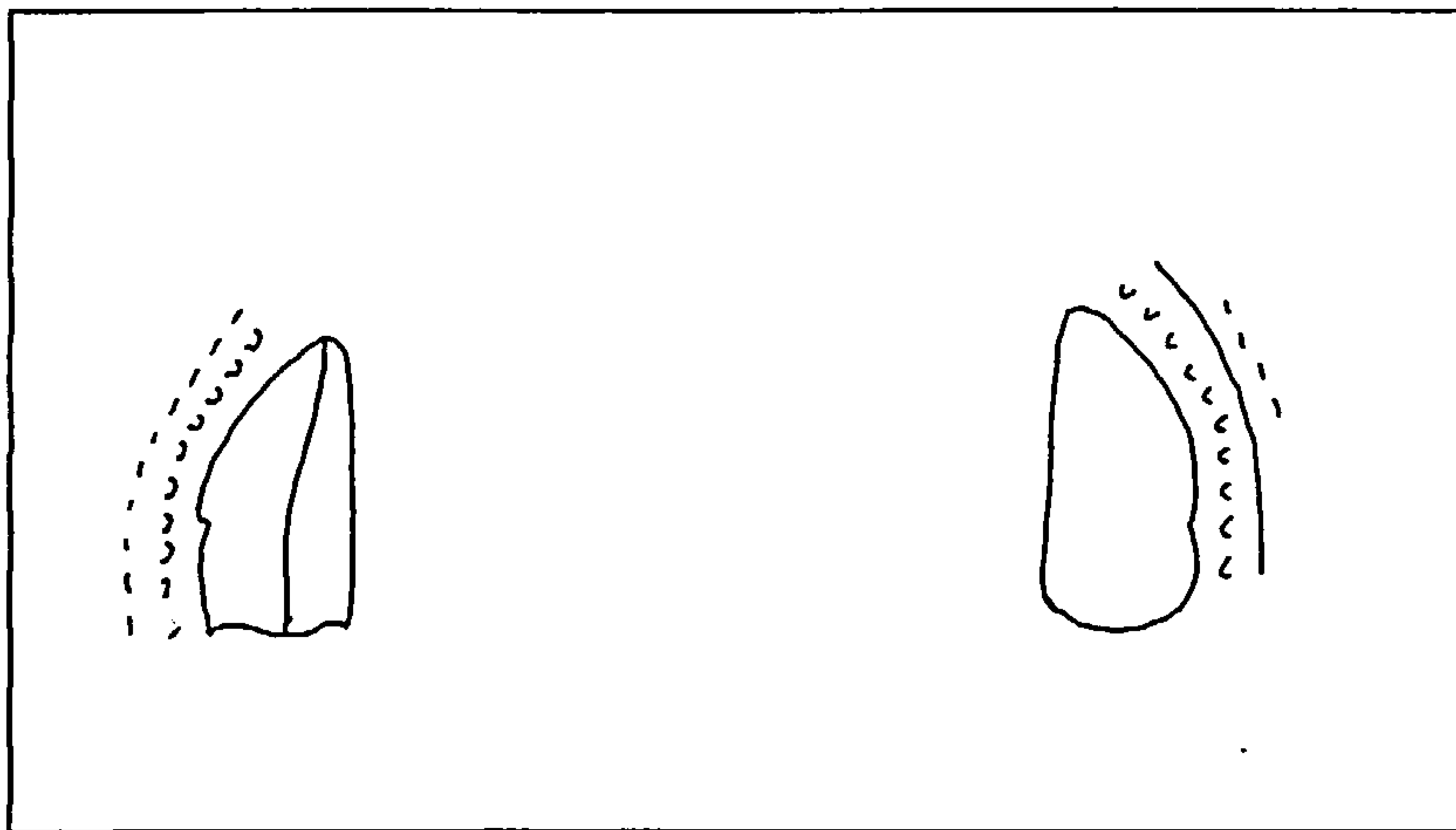
Dorsal side b: regular clustered medium mixed termination mostly deep scars with snaps, associated with a patchy polish on edge. Polish is smooth flat reticulated, partially linked, developed, bright, with abrupt edges and no internal features.

Ventral side b: common clustered small mixed termination mostly deep scars with snaps. No polish

Interpretation: side b used, prob transverse, hard material

Comments: hard to see because of developing patina

Ref: GM1423
Type: ED
Blank: FLAKE
Mat: FLINT
Dim: 18x10x4
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A

Edge Angle: medium

Traces:

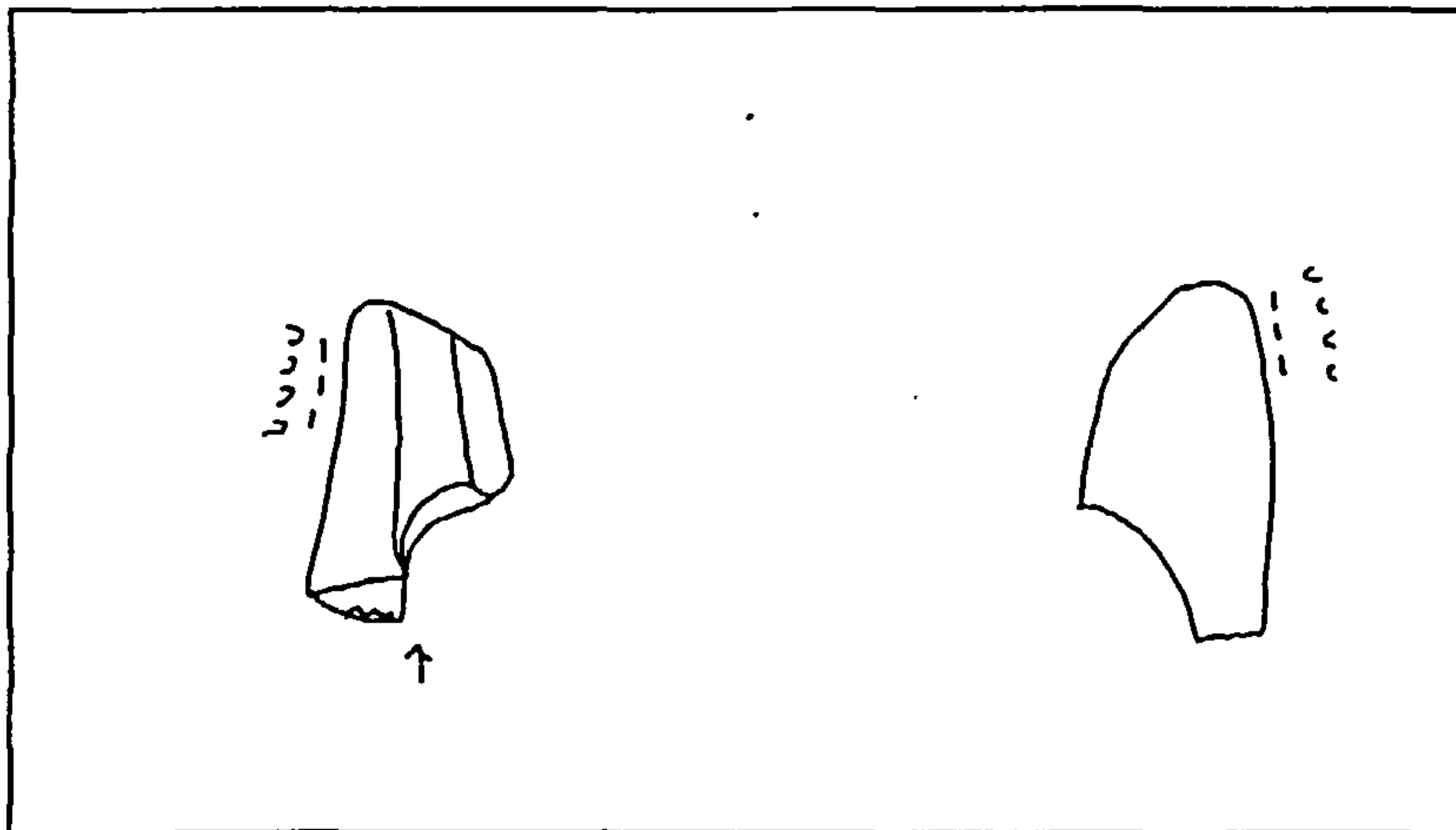
Dorsal side a: frequent clustered small mostly feather terminating deep scars associated with a restricted narrow linear polish along the edge. Polish is smooth flat to reticulated, partially linked, developed, bright, variable with gradual edges (fades from edge) and numerous medium to small circular pits. Best developed between scars.

Ventral side a: frequent clustered and layered large to medium mixed terminating deep scars with snaps. Patchy linear polish along and away from edge. Polish is smooth flat to reticulated, partially linked, developed to intense, bright, widely variable, with fairly sharp edges and frequent medium to small circular pits and parallel to 45o linear elements. Also with a restricted linear polish on and away from edge, perpendicular to edge. Polish is smooth flat reticulated, allover, intense, bright, with abrupt edges and numerous parallel linear elements. Associated with perpendicular long medium fine numerous striations.

Interpretation: side a used, long motion

Comments: perpendicular polish and striations cause large macro scars on dorsal, not connected to other features.

Ref: GM1500
Type: ?BURIN
Blank: FLAKE
Mat: FLINT
Dim: 20x11x3
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
O

Edge Angle: medium

Traces:

Dorsal side a: occasional clustered minute mostly step terminating deep scars with snaps, associated with a restricted narrow linear polish along edge. Polish is smooth domed, partially linked, developed, bright, with sharp edges and no internal features.

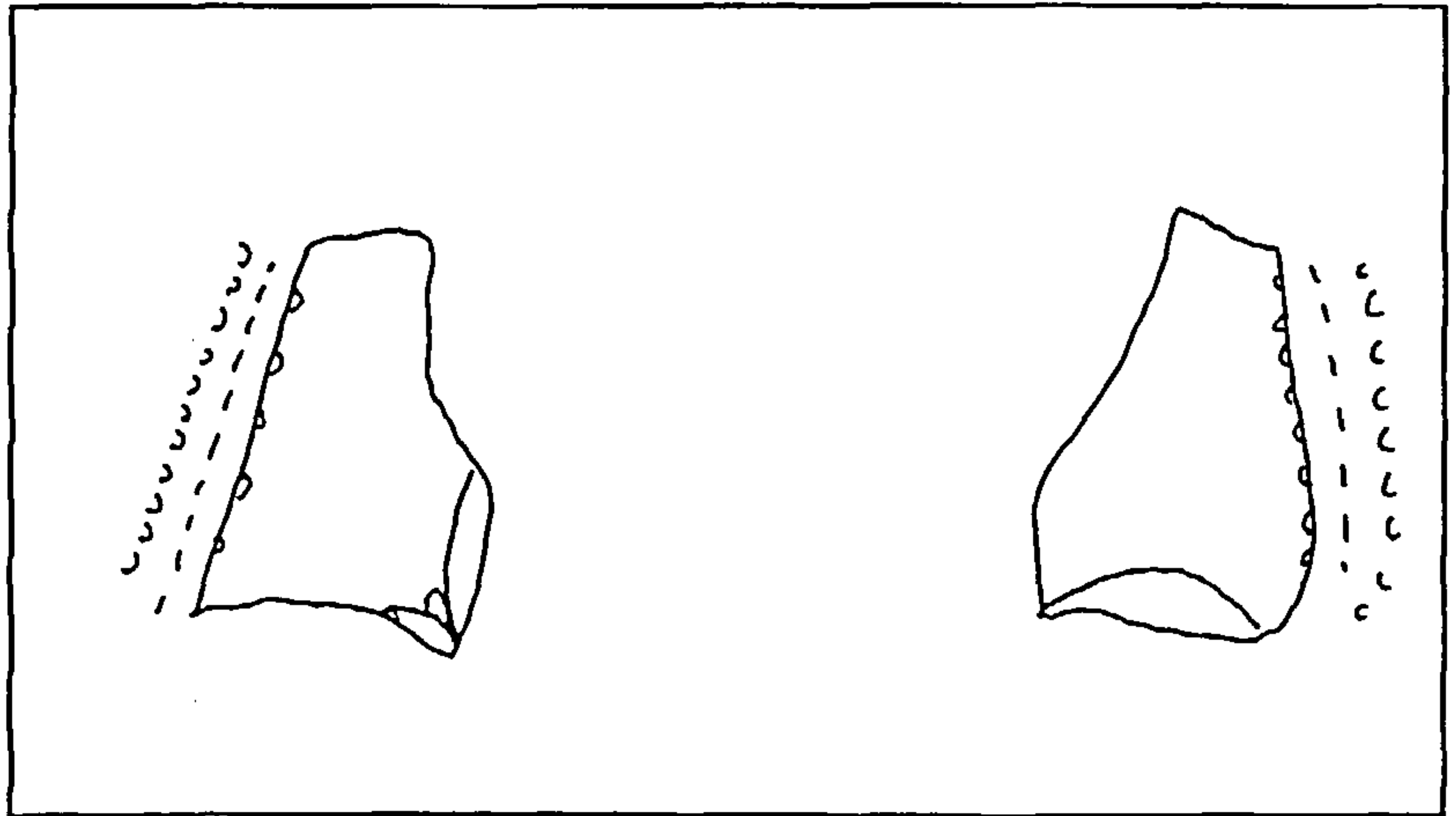
Ventral side a: common clustered small to minute mostly feather terminating mixed scars with snaps, associated with patchy (linear) polish along edge. Polish is smooth domed invasive, partially linked, developed, with gradual edges and no internal features.

Polish forms fine bevel on side a.

Interpretation: side a used, long motion.

Comments: "burin" facet not used, although possibly for prehension/hafting.

Ref: GM1521
Type: ED
Blank: FLAKE
Mat: FLINT
Dim: 30x27x11
Qual: MED
Cond: FRESH



Material: Grain: F Homog: V Crys: A Topo: F Fissures:
O

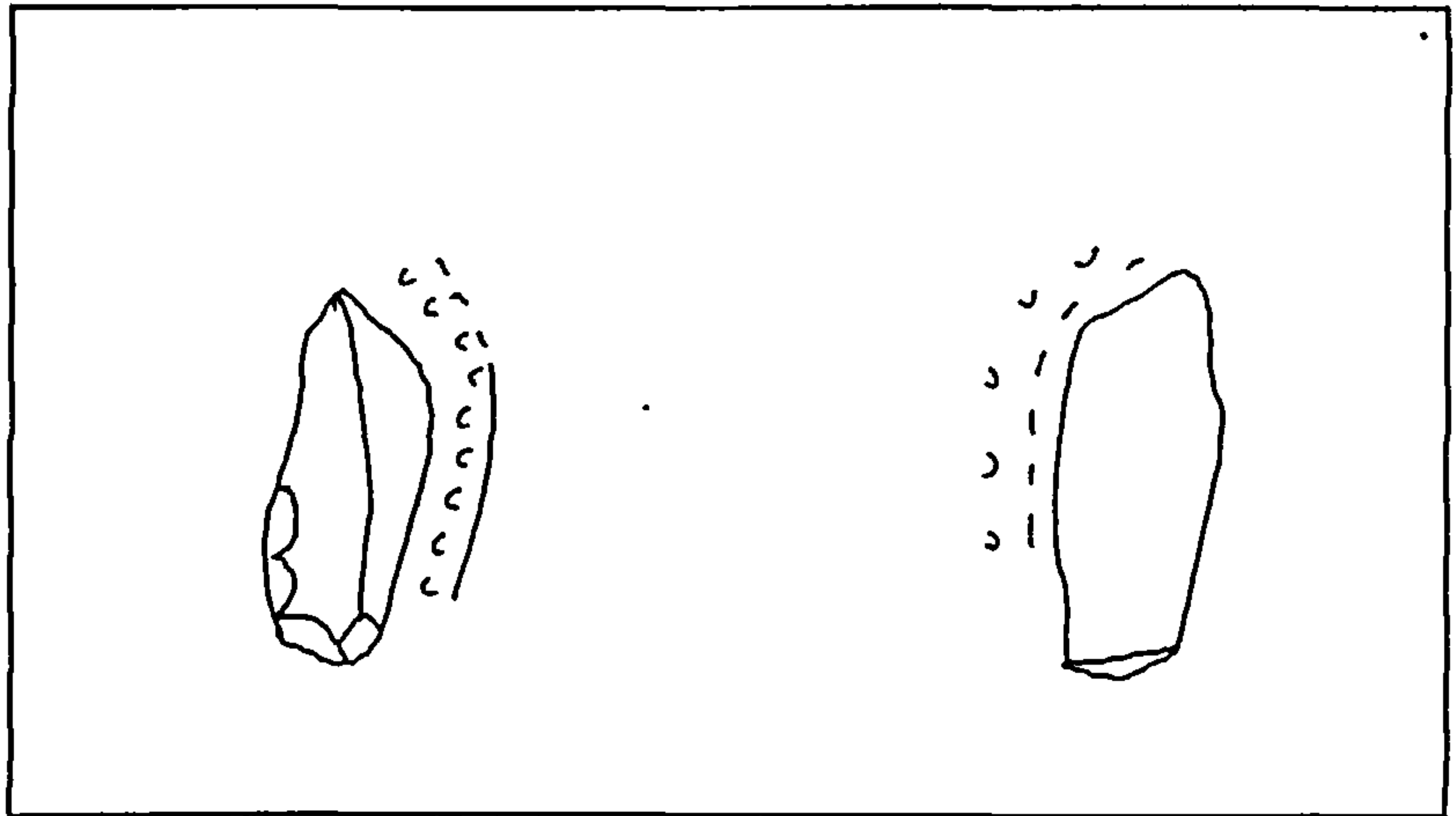
Edge Angle: acute

Traces:

Side a, both faces very similar: common to frequent clustered and layered large to medium mostly step terminating deep scars with snaps. Associated with a broad spread of polish along the edge. Polish is smooth reticulated, partially linked, developed, variable, with gradual edges and no internal features. Alos, on dorsal, patches on edge. Polish is rough reticulated, partially linked, developed, with gradual edges and occasional small circular pits. In both these polishes, restricted patches of smooth invasive polish, allover, developed, with gradual edges and occasional small irregular pits.

Interpretation: side a used, long motion, hard material
Comments:

Ref: GM1531
Type:
Blank: BLADE
Mat: FLINT
Dim: 24x12x4
Qual: EXC
Cond: SP



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
O

Edge Angle: medium

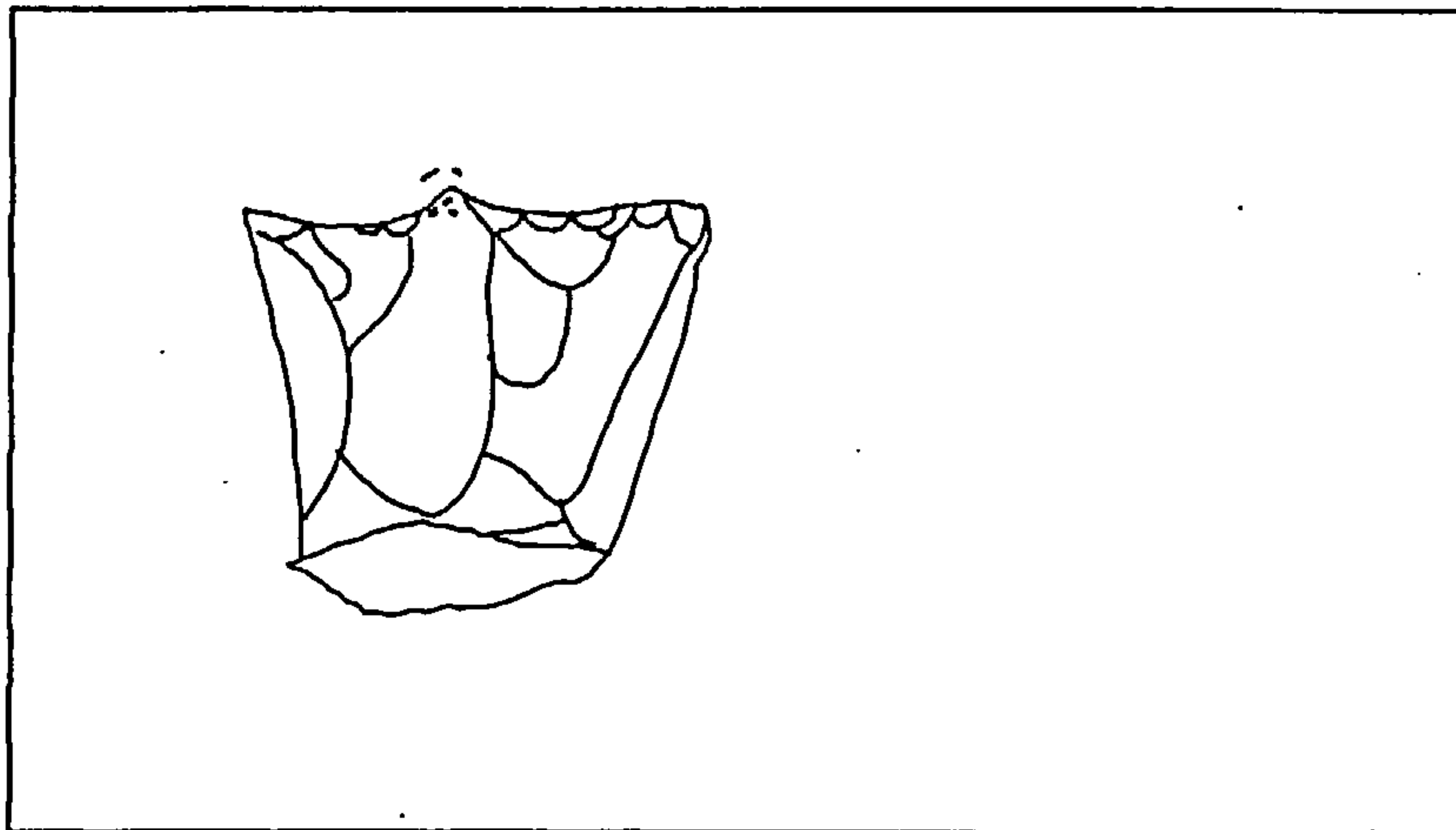
Traces:

Dorsal side b: common clustered minute mostly feather terminating deep scars, associated with a restricted narrow linear polish along edge. polish is smooth domed (invasive) allover, with sharp edges and occasional minute circular pits. Associated are perpendicular short deep fine striations.

Ventral side b: rare scattered minute mostly feather terminating deep scars with snaps. Associated with restricted patchy polish along edge and away from edge. Polish is smooth domed invasive, allover, developed, bright, with sharp edges and frequent minute circular pits.

Interpretation: side b used, prob transverse motion
Comments:

Ref: GM1537
Type: PLATFORM
Blank: CORE
Mat: FLINT
Dim: 29x40x18
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: thick

Traces:

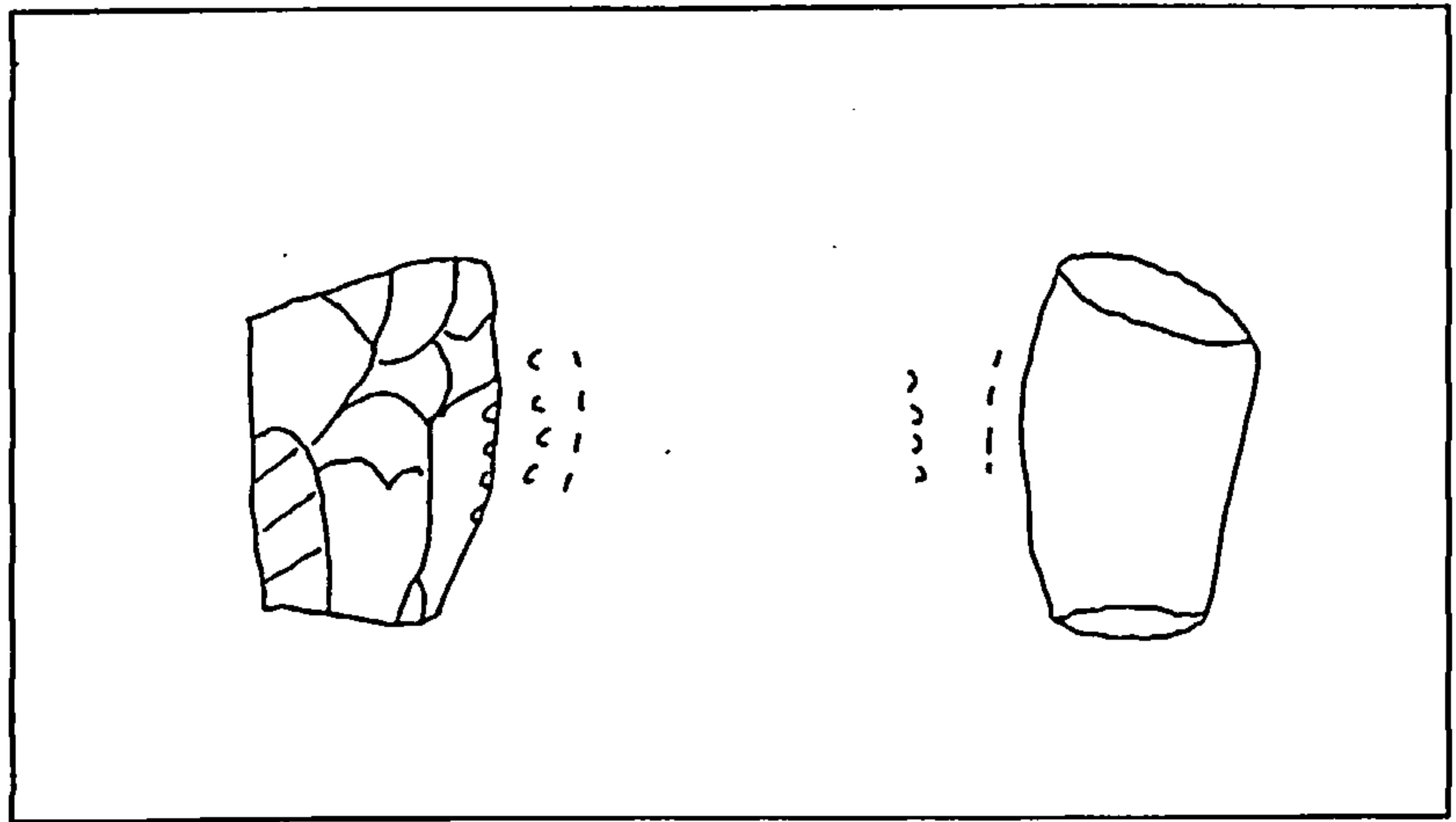
Edge damage not recorded because of preparation scars.

Restricted patchy polish on and away from edge.
Polish is smooth domed invasive, partially linked,
variable, with gradual edges and occasional medium
irregular pits.

Interpretation: spur probably used

Comments: techno features do not cause problems, as spur
is very fresh - unless of course noted polish is an
unusual techno feature - doesn't look like one

Ref: GM1595
Type: ED
Blank: FLAKE
Mat: FLINT
Dim: 27x21x5
Qual: EXC
Cond: W



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
C

Edge Angle: acute

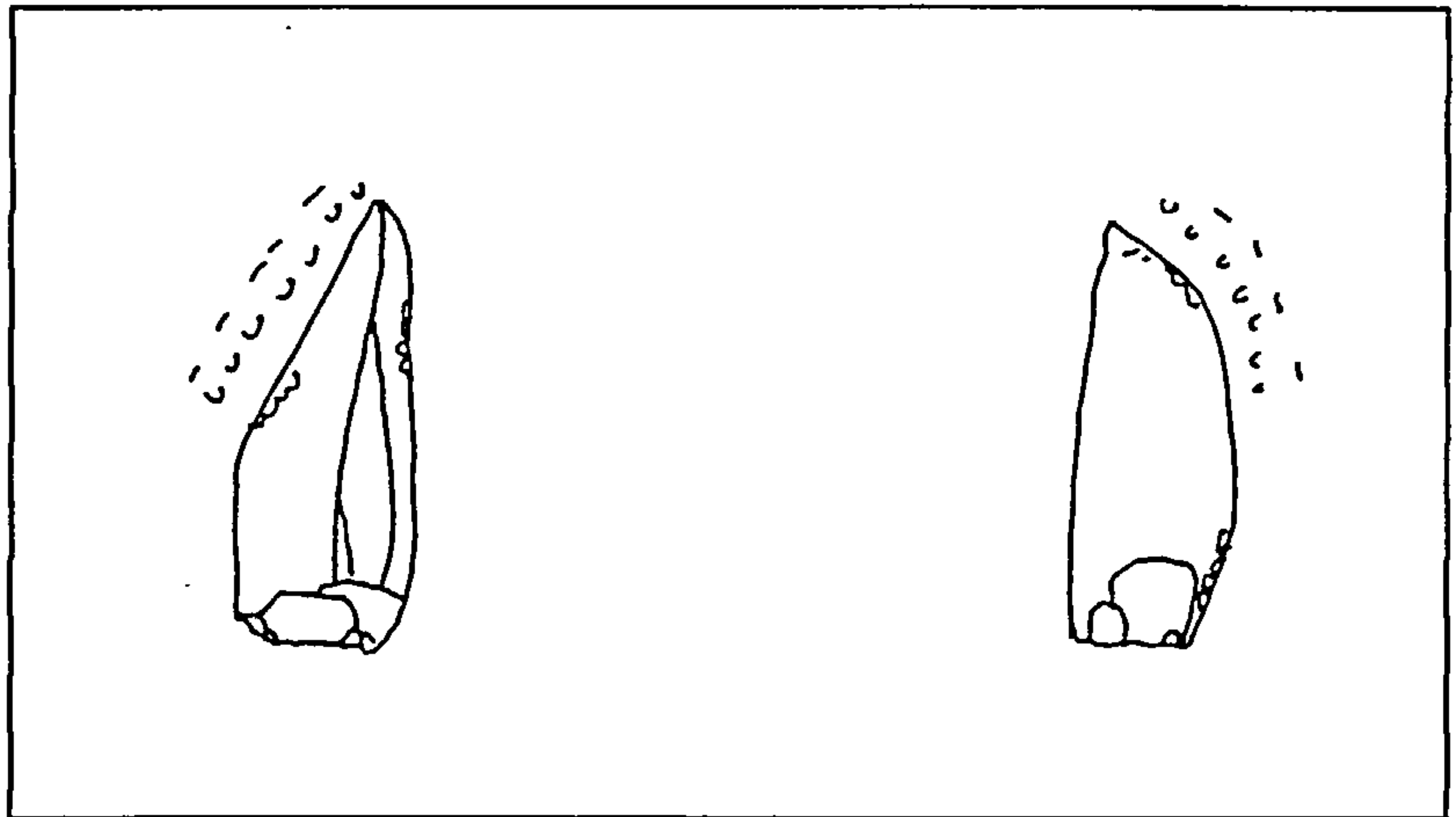
Traces:

Side b, both faces very similar: occasional to common large to small mostly feather terminating deep scars, associated with restricted patchy polish on edge. Polish is smooth domed invasive, partially linked, developed, with gradual edges and no internal features.

Interpretation: side b used, long motion

Comments:

Ref: GM1625
Type: ED
Blank: BLADE
Mat: FLINT
Dim: 29x14x4
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
O

Edge Angle: acute

Traces:

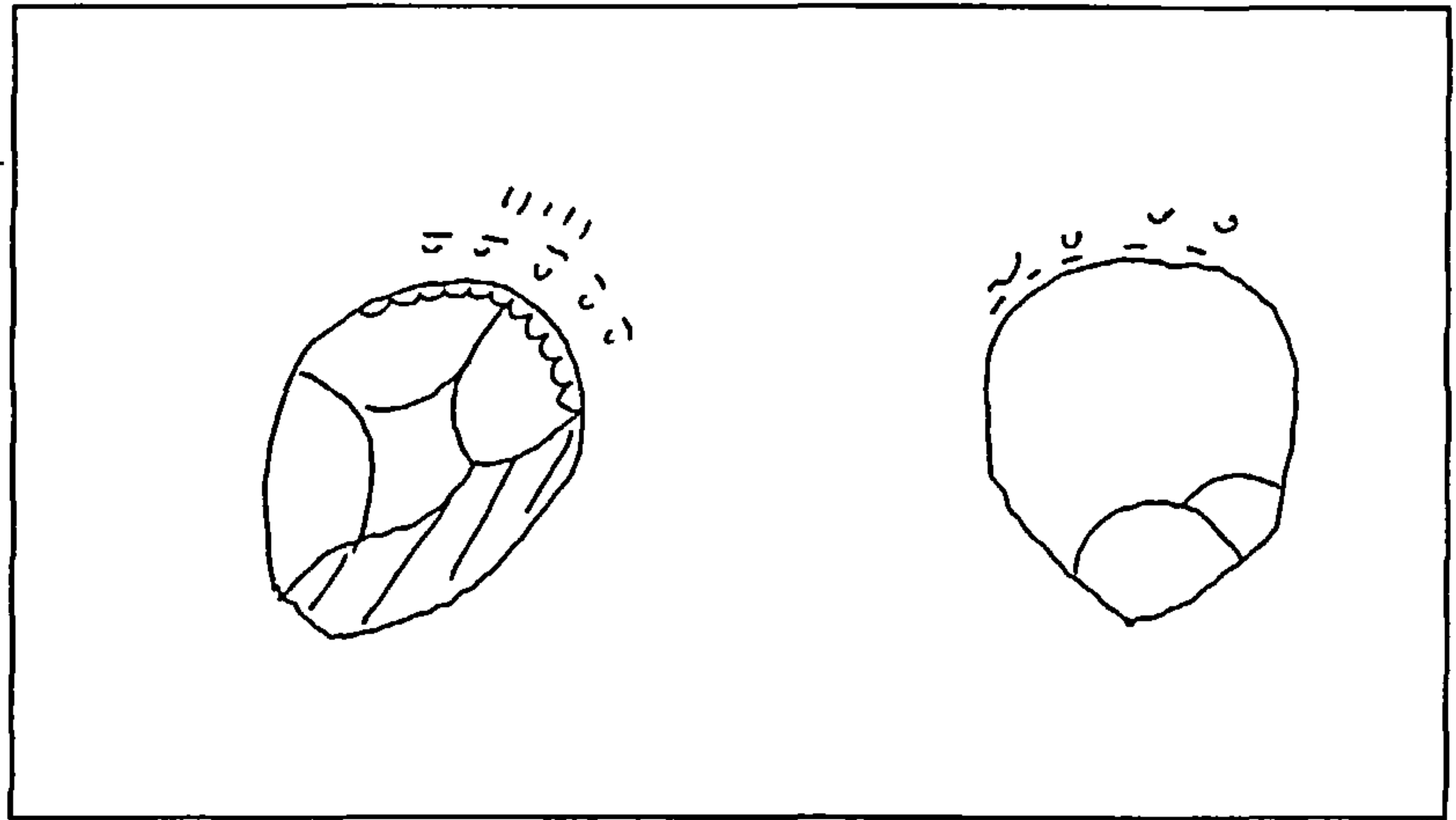
Side a, edge damage identical on both faces: common
clustered large snap fractures

Dorsal side a: patchy linear polish along edge.
Polish is smooth domed, allover, developed, with
sharp edges and common medium circular pits. Some
linearity at 75o to edge.

Ventral side a; restricted narrow linear polish
along edge. Polish is smooth domed, partially
linked, with abrupt edges and occasional small
circular pits.

Interpretation: side a used, prob long motion
Comments:

Ref: GM1650
Type: SCRAPER
Blank: FLAKE
Mat: FLINT
Dim: 19x26x10
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures: A

Edge Angle: thick

Traces:

Edge damage hard to see because of retouch

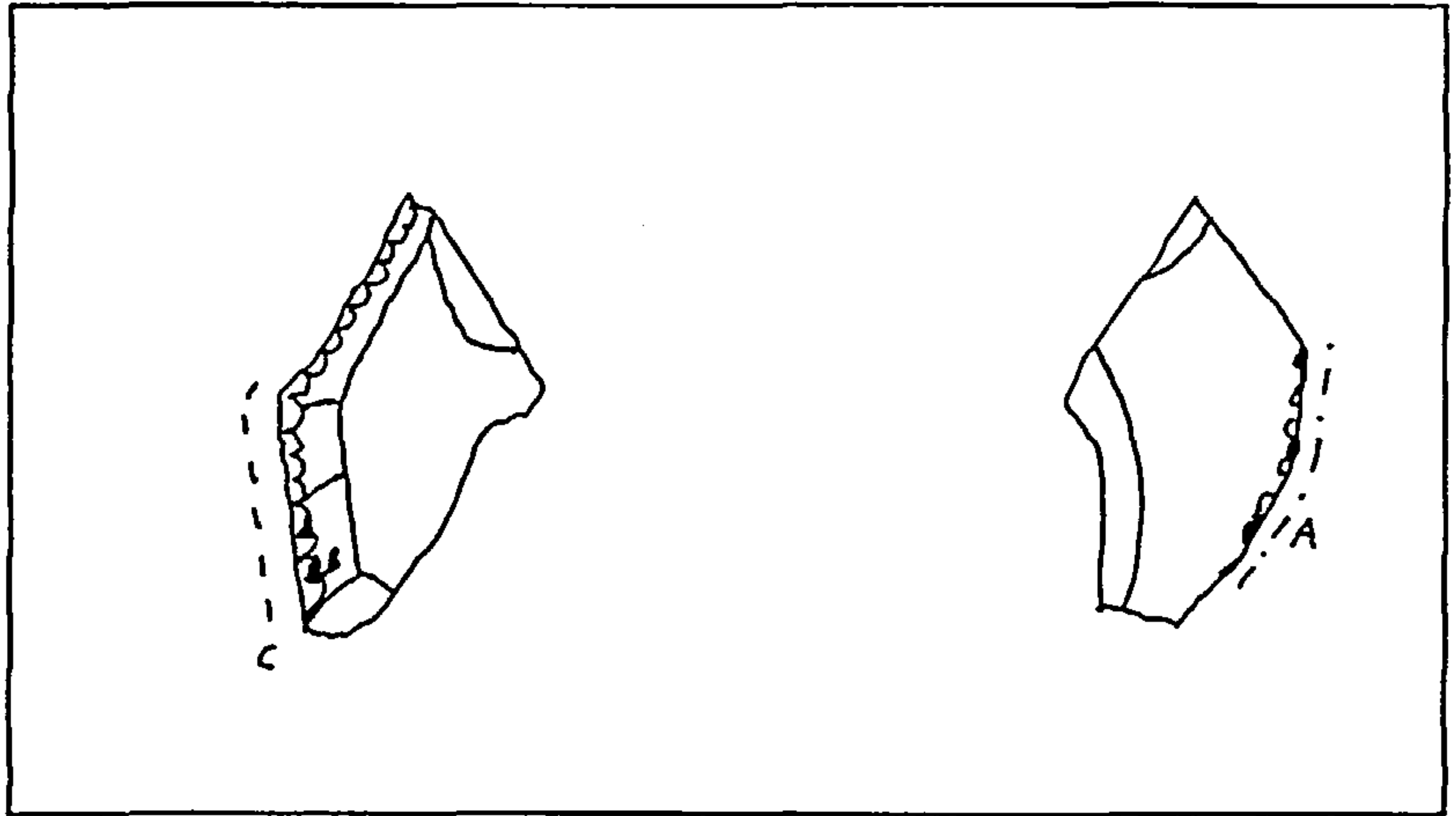
Dorsal distal: common clustered small mostly step deep scars with snaps. associated with patchy polish on and away from edge. Polish is rough reticulated, partially linked, variable, with frequent minute circular pits. Associated with perpendicular short deep fine striations.

Ventral distal: rare clustered large to medium mostly feather terminating deep scars associated with patchy polish on the edge. Polish is rough reticulated, scattered, poor, with gradual edges and no internal features.

On extreme distal edge: restricted narrow linear polish along edge. Polish is smooth domed, partially linked, developed, with fairly sharp edges and occasional medium irregular pits.

Interpretation: distal end used, transverse motion
Comments:

Ref: GM1770
Type: SCRAPER
Blank: FLAKE
Mat: FLINT
Dim: 29x19x7
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: thick

Traces:

Edge damage not recorded because of retouch

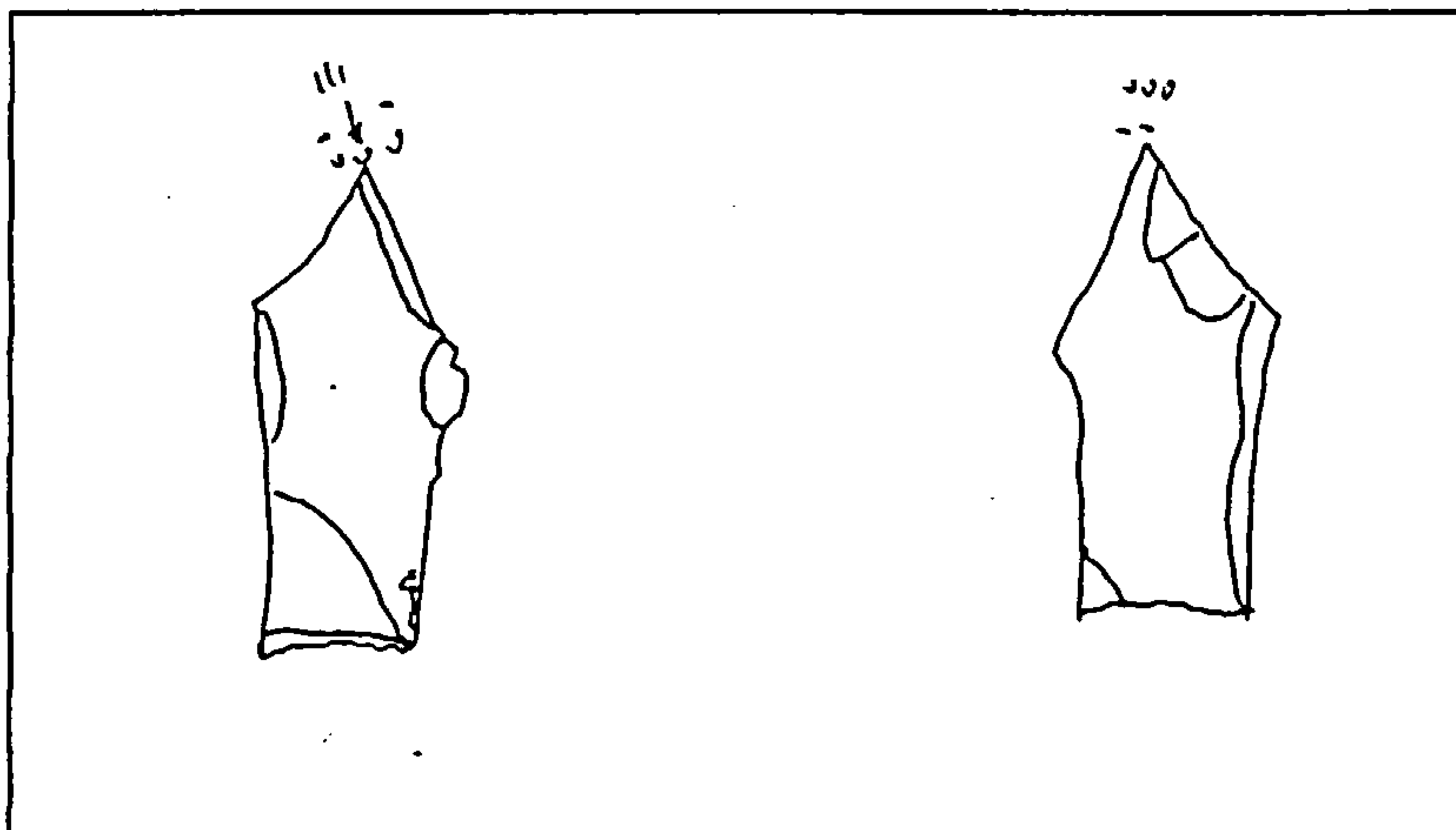
Polish A: patchy spread along and away from edge. polish is smooth domed (invasive, fluid infilling), allover, developed, variable, with fairly sharp edges and common variable circular pits.

Polish B: patchy spread along edge. Polish is smooth domed, allover, deep, with abrupt edges and common variable irregular pits. Associated with 750 long deep narrow frequent striations.

Polish C: patchy polish on edge and on retouch ridges. Polish is smooth domed, allover, developed, bright, with sharp edges and common minute circular pits,

Interpretation: side a used, transverse motion
Comments: scraper used as scraper

Ref: GM1771
Type: ?BURIN
Blank: FLAKE
Mat: FLINT
Dim: 34x18x4
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A

Edge Angle: point

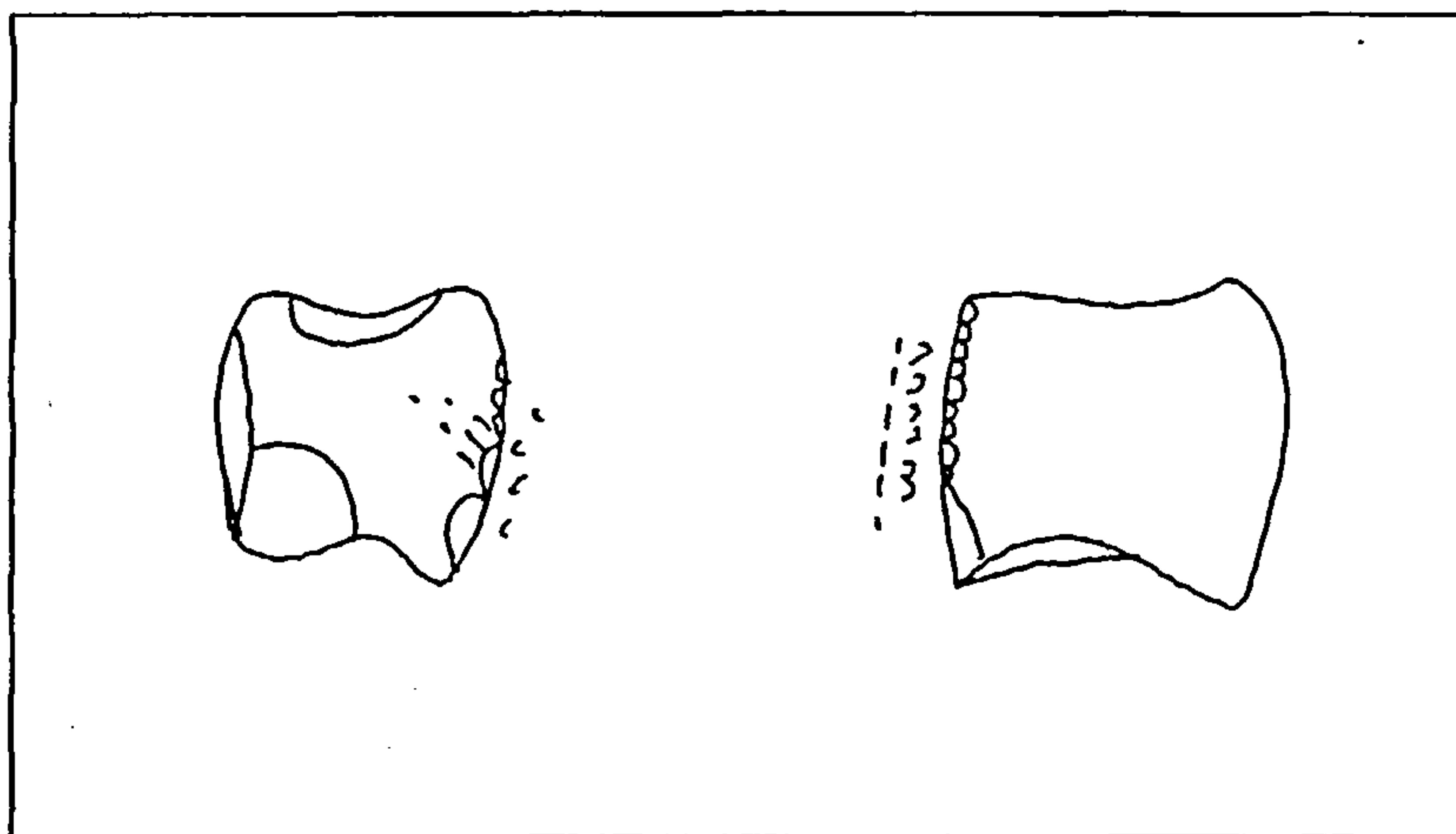
Traces:

Tip of point: common clustered medium to small mostly step terminating mostly shallow scars. Associated with restricted patchy polish on edge. Polish is smooth domed invasive, partially linked, developed, variable, with gradual edges and occasional medium irregular pits. Associated with perpendicular to tip, short deep narrow striations.

Interpretation: burin facet at tip used

Comments: used as burin

Ref: GM1777
Type: SCRAPER
Blank: FLAKE
Mat: FLINT
Dim: 18x21x6
Qual: MED
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: thick

Traces:

Dorsal side b: occasional clustered large mostly feather terminating deep scars, associated with patchy linear (750) polish on interior face. Polish is rough reticulated, scattered, intense, bright, with abrupt edges and no internal features.

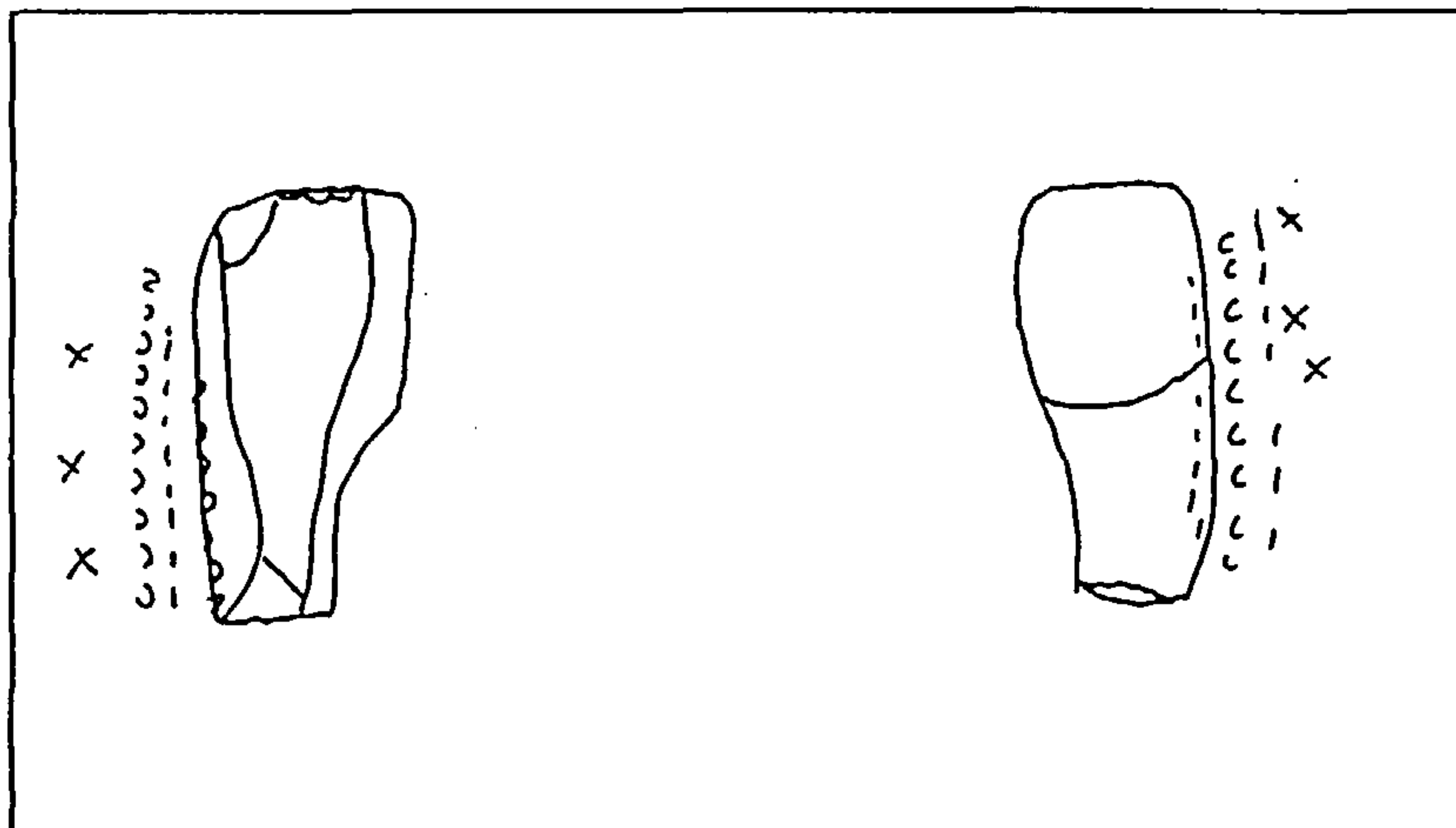
Ventral side b: edge damage not recorded because of retouch. Patchy spread of polish on and away from edge. Polish is smooth flat/domed/invasive with fluid infilling, allover, intense, bright, widely variable, with gradual edges and occasional minute irregular pits.

Side a, both faces: restricted patchy polish on interior. Polish is smooth flat, partially linked, with sharp edges and occasional minute irregular pits.

Interpretation: side b used, transverse motion, hard material.

Comments: polish near side a = hafting. Polish on dorsal side b too intense for retouch hammer marks

Ref: GM1801
Type: ED
Blank: FLAKE
Mat: FLINT
Dim: 24x13x4
Qual: MED
Cond: PATINA



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: thick

Traces:

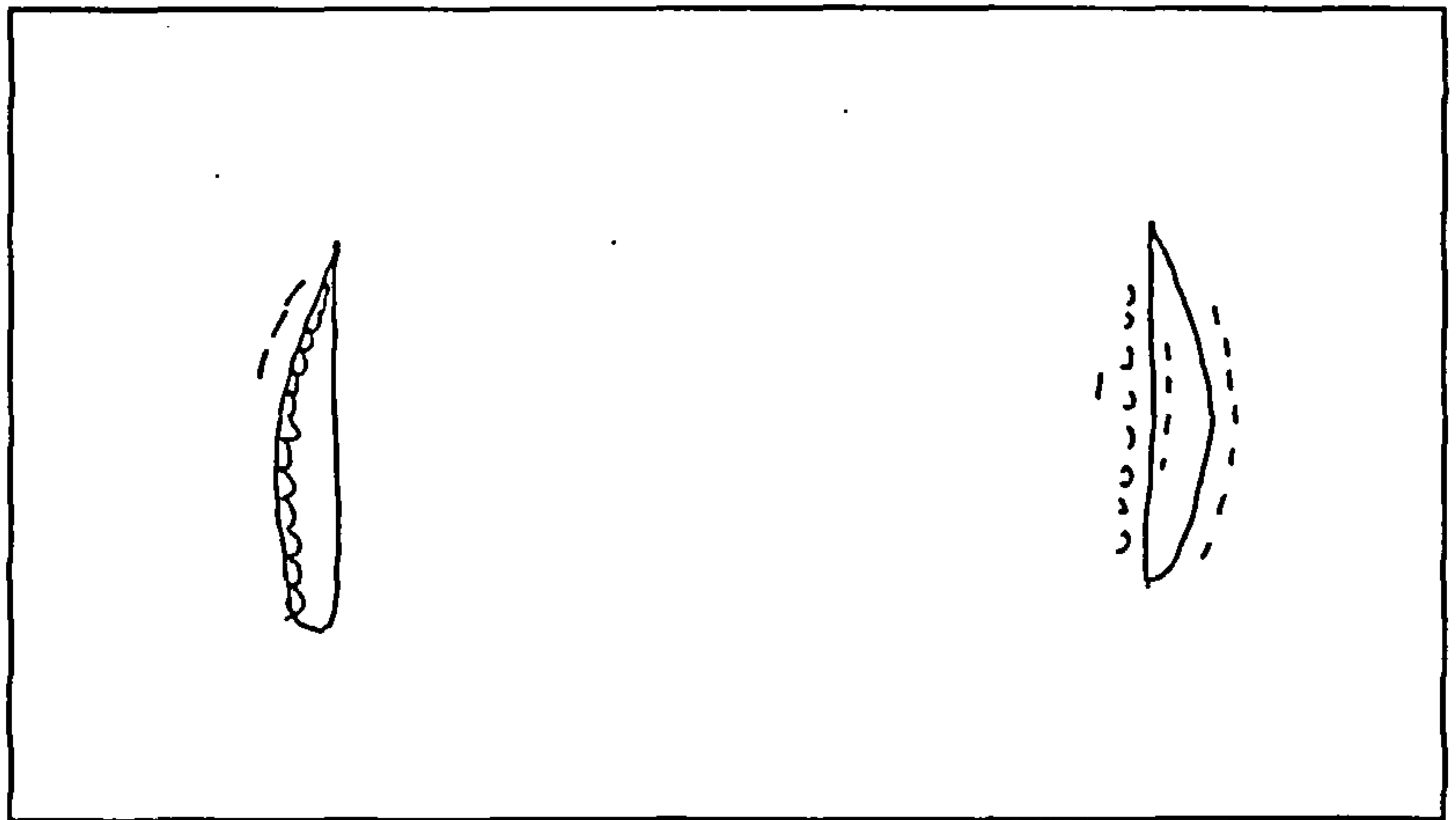
Dorsal side a: frequent clustered medium to small mostly feather terminating mostly deep scars. Associated with patchy polish away from edge. Polish is smooth reticulated (invasive), scattered, poor, with gradual edges and occasional small irregular pits.

Ventral side a: common clustered small to minute mixed termination mostly deep scars, associated with a broad spread of polish away from edge. Polish is smooth domed (reticulated), scattered, variable, with sharp edges and occasional small irregular pits.

At X, both faces: restricted patches away from edge. Polish is smooth flat, partially linked, developed, with abrupt edges and frequent medium irregular pits.

Interpretation: side a used, long motion
Comments:

Ref: GM1865
Type: MICRO
Blank: BLADE
Mat: FLINT
Dim: 14x3x2
Qual: GOOD
Cond: FRESH



Material: Grain: F Homog: H Crys: O Topo: F Fissures:
A

Edge Angle: thick

Traces:

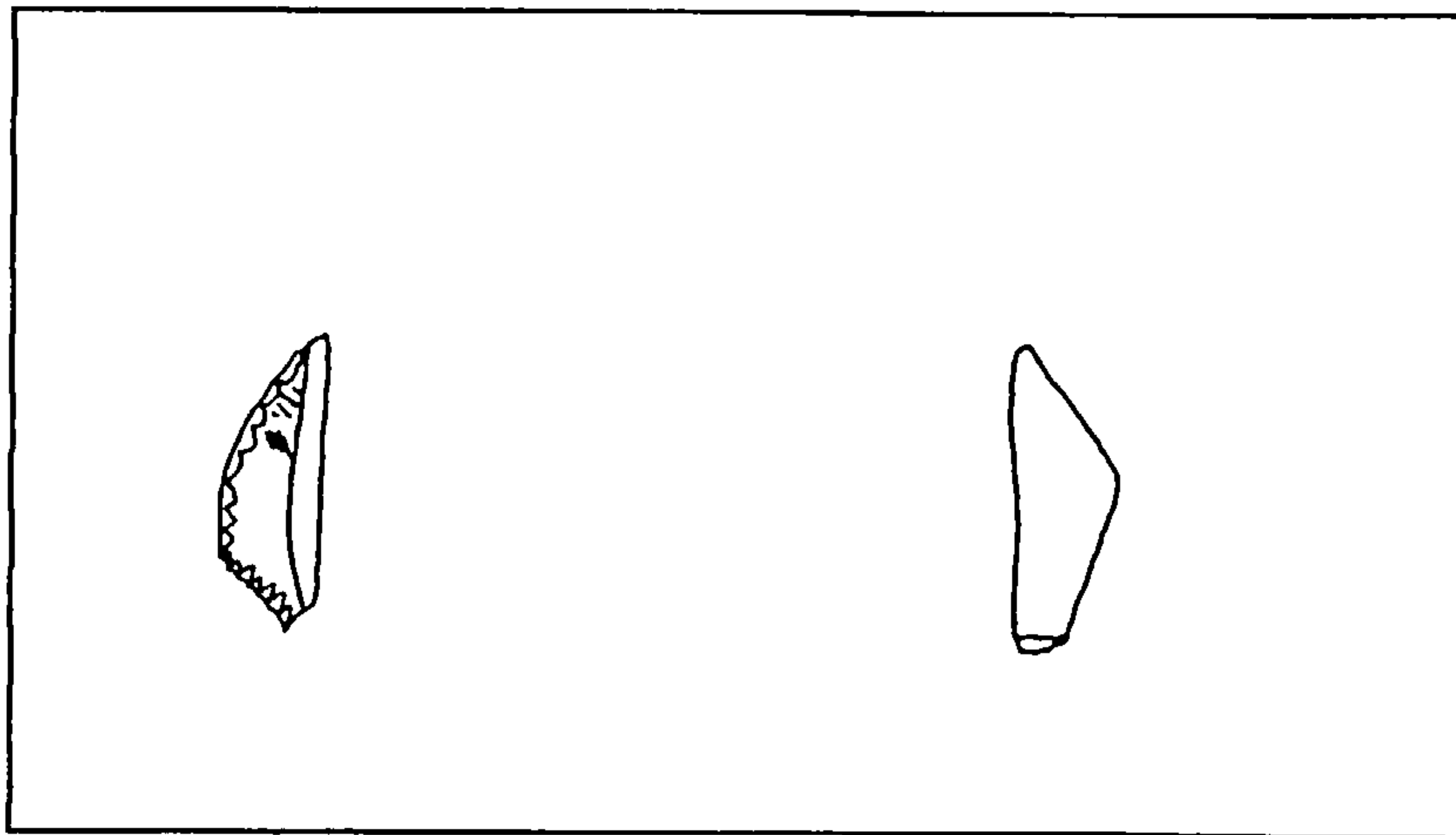
Dorsal side a: edge damage not recorded because of retouch. Restricted narrow linear polish along ridges away from edge. Polish is smooth domed, partially linked, bright, with abrupt edges and no internal features.

Ventral side a: Edge damage not recorded because of retouch. Broad spread of polish along edge. Polish is smooth flat/domed, partially linked, developed, bright, variable, with fairly sharp edges and rare medium circular pits.

Ventral side b: numerous clustered large to medium feather terminating deep scars, associated with a restricted spread of polish away from the edge. Polish is rough reticulated partially linked, with sharp edges and occasional large irregular pits.

Interpretation: side b used
Comments:

Ref: GM1886
Type: MICRO
Blank: BLADE
Mat: FLINT
Dim: 8x3x2
Qual: EXC
Cond: PATINA



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A

Edge Angle: thick

Traces:

Edge damage not recorded because of retouch

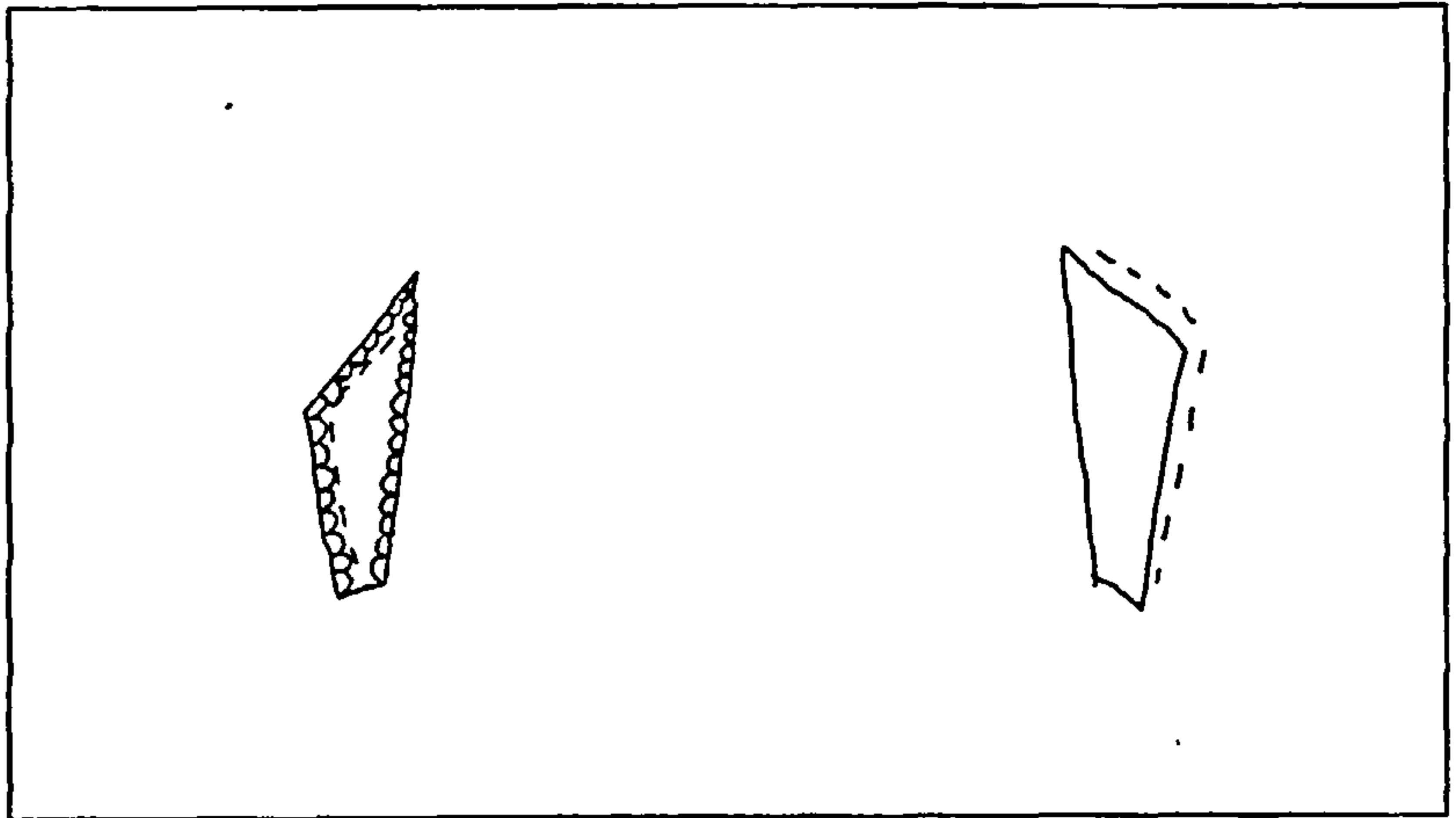
Polish A: patchy narrow linear polish perpendicular to edge. Polish is smooth reticulated, partially linked, with sharp edges and no internal features.

Polish B: patchy polish on interior face. Polish is smooth flat, all over, with sharp edges and common medium irregular pits

Interpretation: used

Comments: all features on dorsal face

Ref: GM1891
Type: MICRO
Blank: BLADE
Mat: FLINT
Dim: 8x3x2
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A

Edge Angle: thick

Traces:

Edge damage not recorded because of retouch

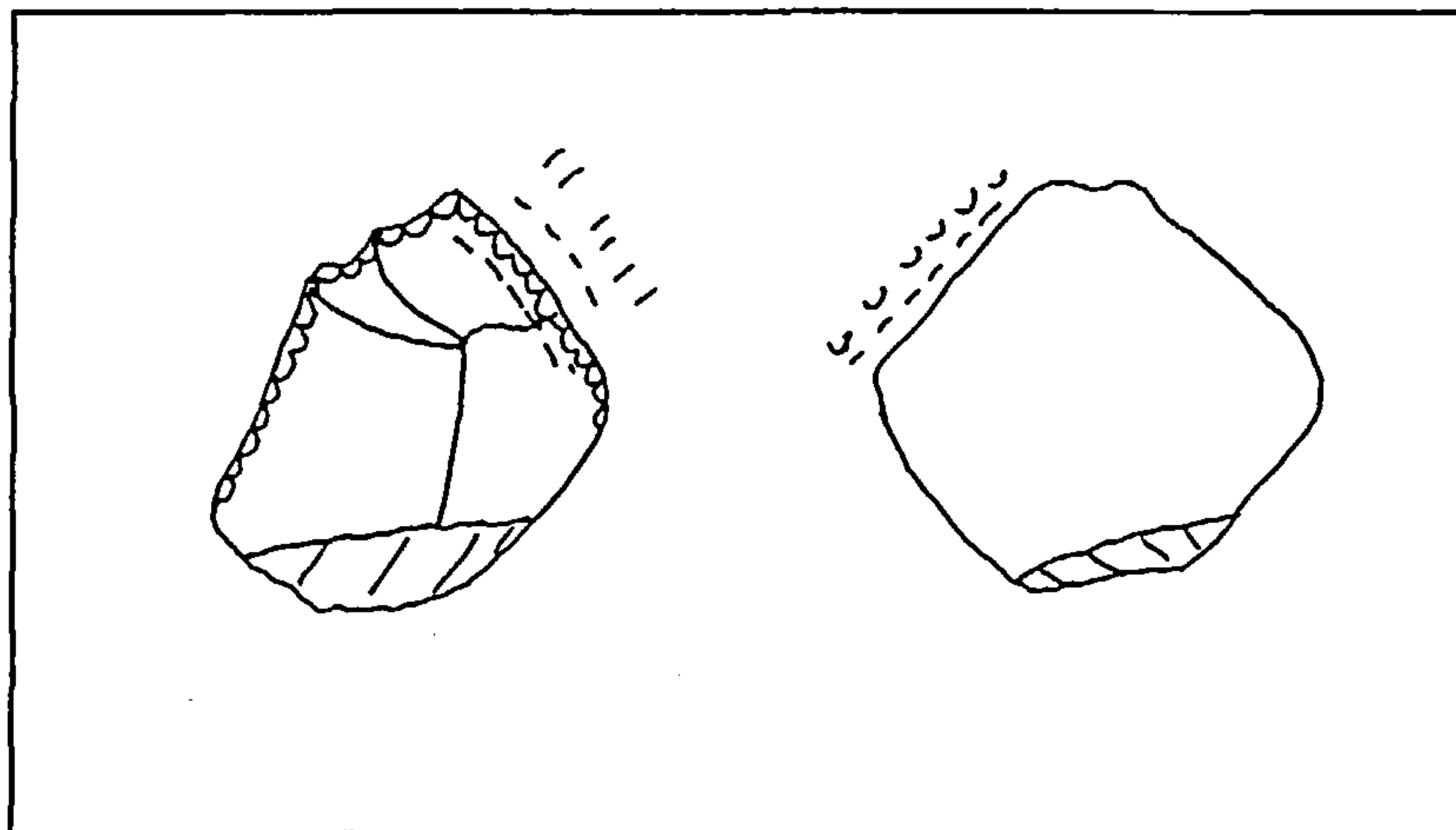
Dorsal: restricted narrow linear polish along
ridges. Polish is rough reticulated, partially
linked, with abrupt edges and no internal features.

Ventral: broad spread on interior and narrow linear
along edge. Polish is rough reticulated, partially
linked, variable, with abrupt edges and no internal
features.

Interpretation: Used

Comments: distribution on ventral and degree of
development stop traces looking like techno traces.

Ref: GM1901
Type: SCRAPER
Blank: FLAKE
Mat: FLINT
Dim: 24x31x13
Qual: EXC
Cond: FRESH



Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A

Edge Angle: thick

Traces:

Dorsal side b: edge damage not recorded because of retouch. Patchy polish away from edge. Polish is smooth domed, partially linked, developed, bright, variable, with fairly sharp edges and occasional minute circular pits.

Ventral side b: rare clustered large mostly feather terminating deep scars, associated with patchy polish away from edge. Polish is smooth flat, partially linked, developed, with abrupt edges and frequent small to minute irregular pits.

Side b, on extreme edge: Patchy narrow linear polish along edge. Polish is smooth domed invasive, partially linked, variable, with gradual edges and no internal features. Associated with perpendicular short deep narrow striations.

Interpretation: side b used, transverse motion
Comments: scraper used as scraper

Gleann Mor: Sample with use traces

N	Type	MOTION	HARD	MATERIAL	FUNCTION	NOTES
63	USED	TRANSV	MED S		SCRAPE	
112	USED	CIRCUL	SOFT		BORE	
132	OPP USE	?	?			
138	USED	TRANSV	MED H		SCRAPE	
144	USED	TRANSV	MED S		SHAVE	MARGINAL
170	USED	LONG	SOFT			
171	USED	TRANSV	MED S		SHAVE	
183	USED	LONG	SOFT			
185	USED	LONG	MED S			
205	USED	BIDIR	MED S			
239	USED	CIRCUL	MED S		BORE	
348	USED	TRANSV	MED S		SCRAPE	2 USES
348	USED	LONG	MED S			2 USES
409	USED	?	SOFT			LONG
508	USED	LONG	?		GROOVE?	
606	USED	TRANSV	MED			2 MOTIONS
633	USED	?	?			
825	USED	CIRCUL	MED H		BORE	
832	USED	LONG	MED H			
902	USED	CIRCUL	HARD		BORE	
930	USED	TRANSV	MED H			
934	USED	TRANSV	MED H		SHAVE	
937	USED	LONG	MED			
939	USED	PIERCE	MED H		PIERCE?	COMPLEX
943	USED	BIDIR	MED S			
952	USED	LONG	MED S			
967	USED	TRANSV	MED		SHAVE	POS LONG
982	USED	LONG	MED			
1003	USED	LONG	?		PROJECTILE	
1117	USED	LONG	MED H			
1146	USED	TRANSV	MED H		SHAVE	
1158	USED	LONG	MED S			2ND USE?
1163	USED	COMPLE				SEVERAL USES?
1211	USED	TRANSV	MED			
1218	USED	BIDIR	MED H			2ND USE?
1289	USED	LONG	MED S			
1318	USED	LONG	MED H			
1335	USED	?	?			COMPLEX
1388	OPP USE	LONG	MED			
1393	USED	TRANSV	MED S		SHAVE	
1395	USED	TRANSV	MED S			
1396	USED	TRANSV	MED S			
1419	USED	LONG	?			
1423	USED	LONG	MED			
1500	USED	LONG	MED			
1521	USED	LONG	MED H			
1531	USED	TRANSV	MED S		SHAVE	
1537	OPP USE	?	?			
1595	USED	TRANSV	MED S		SHAVE	
1625	USED	LONG	MED H			

N	Type	MOTION	HARD	MATERIAL	FUNCTION	NOTES
-----	-----	-----	-----	-----	-----	-----
1650	USED	TRANSV	MED H			
1770	USED	TRANSV	MEDü			
1771	USED	PIERCE	MED H			
1777	USED	TRANSV	MED		SHAVE	
1801	USED	LONG	MED			
1865	USED	?	?			
1886	USED	?	?			POS PROJ
1891	USED	COMPLE	MED H			
1901	USED	TRANSV	MED S			

Gleann Mor: Sample analysed for function

Number	TYPE	Blank	Retouched	L	B	T
-----	-----	-----	-----	--	--	--
31	no traces	F	Y			
46	techno	CORE	N	23	33	25
57	techno	F	Y	20	26	9
63	used	CORE	N	25	28	22
75	PDSM	F	Y	15	10	7
80	PDSM	B	Y	23	11	4
83	PDSM	F	L	30	20	10
87	NP	B	L	25	9	6
88	no traces	B	N	23	6	3
91	PDSM	F	Y	14	8	2
103	techno	F	Y	19	19	7
112	used	B	Y	12	3	2
125	techno	CORE	N	20	29	26
132	used	F	N	18	20	8
134	NP	CORE	N	27	22	6
138	used	F	Y	18	25	8
144	used	F	Y	15	13	3
151	NP	F	Y			
164	NP	F	Y	24	15	8
170	used	F	Y	21	18	7
171	used	F	L	42	30	12
172	techno	F	Y	27	18	6
183	used	F	N	19	11	3
185	used	F	Y	12	10	3
205	used	F	Y	22	12	3
239	used	B	Y	14	4	3
270	no traces	F	N	15	13	6
318	techno	B	Y	8	2	2
348	used	F	Y	17	19	4
409	used	B	Y	18	3	2
434	techno	B	Y	32	13	7
477	no traces	F	Y	33	24	10
478	no traces	CORE	N	30	48	38
481	techno	CORE	N	26	31	27
508	used	F	L	21	14	3
532	techno	B	Y			
556	NP	CORE	N	35	12	8
563	techno	B	Y	19	5	2
570	techno	F	Y	13	7	3
587	no traces	B	Y			
600	techno	B	Y	12	6	2
602	no traces	F	Y	23	14	5
606	used	F	L	21	13	6
633	used	CORE	N	24	24	11
637	no traces	B	Y	17	5	2
652	techno	F	Y	21	22	8
675	no traces	F	Y	12	25	17
677	techno	CORE	N	32	44	33
694	PDSM	F	L	20	15	5
718	no traces	F	Y	20	19	7
726	no traces	F	Y	13	9	2

Number	TYPE	Blank	Retouched	L	B	T
-----	-----	-----	-----	--	--	--
742	techno	CORE	N	34	31	15
810	PDSM	B	Y			
822	techno	B	Y			
823	techno	B	L	32	10	11
825	used	B	N	22	11	5
832	used	F	Y	16	10	5
881	PDSM	F	Y	22	25	7
883	techno	CORE	N	31	31	25
901	PDSM	F	N	7	17	4
902	used	F	N	26	15	8
917	no traces	CH	Y	10	11	8
919	no traces	F	N	19	19	6
930	used	B	N	31	11	6
934	used	B	Y	23	8	3
937	used	F	L	15	15	4
939	used	B	L	21	7	3
942	PDSM	F	Y	21	16	5
943	used	F	N	17	10	5
947	PDSM	F	L	30	17	7
952	used	F	Y	23	13	3
962	PDSM	CH	N	32	19	13
967	used	F	N	12	14	4
968	no traces	B	Y			
982	used	CH	L			
1000	techno	B	Y			
1001	no traces	B	Y	11	3	2
1002	no traces	B	Y			
1003	used	B	Y	11	4	1
1016	no traces	F	Y	21	11	6
1017	techno	B	Y	11	4	2
1018	no traces	B	Y			
1040	techno	B	Y			
1041	no traces	B	Y	11	3	2
1042	no traces	F	Y			
1083	PDSM	B	L	29	14	5
1089	PDSM	B	L	11	5	2
1090	no traces	B	Y	12	3	2
1091	NP	B	Y			
1104	techno	F	N	23	24	4
1117	used	F	L	42	32	10
1120	PDSM	F	Y	28	23	8
1130	PDSM	F	N	21	20	6
1133	no traces	F	N	15	16	3
1134	NP	B	N	17	5	3
1146	used	F	Y	22	15	8
1158	used	F	Y	35	23	17
1163	used	F	L	27	24	4
1164	techno	B	Y	14	4	2
1176	techno	B	L	41	17	7
1188	techno	F	N	36	46	14
1195	techno	CORE	N	17	25	7
1206	techno	CORE	N	32	31	17
1211	used	F	Y	22	30	10

Number	TYPE	Blank	Retouched	L	B	T
-----	-----	-----	-----	--	--	--
1212	no traces	F	Y	21	11	6
1216	techno	CORE	N	30	29	25
1218	used	F	L	31	42	10
1221	techno	F	N	25	10	7
1259	techno	CORE	N	27	25	25
1276	no traces	F	N	11	15	5
1286	PDSM	F	N	20	12	3
1289	used	F	L	23	15	5
1318	used	B	Y	25	12	3
1334	PDSM	CORE	N	24	25	9
1335	used	B	Y	18	3	2
1338	NP	B	Y	14	4	2
1362	PDSM	B	L	34	17	7
1367	no traces	F	N	13	28	8
1384	no traces	F	N	19	22	5
1386	techno	B	L	23	10	2
1388	used	F	N	17	15	4
1392	no traces	B	N	18	8	3
1393	used	F	L	24	25	6
1394	NP	B	N	25	10	3
1395	used	B	N	31	11	7
1396	used	B	L	19	7	2
1411	PDSM	B	N	33	15	6
1419	used	F	L	11	9	3
1422	no traces	F	Y	13	12	5
1423	used	F	L	18	10	4
1443	techno	F	Y			
1448	PDSM	F	N	20	14	5
1466	no traces	F	Y	11	10	4
1482	no traces	CORE	N	27	17	16
1483	techno	CORE	N	17	15	5
1484	PDSM	F	Y	17	18	5
1500	used	F	Y	20	11	3
1505	techno	B	Y			
1521	used	F	L	30	27	11
1531	used	B	N	24	12	4
1537	used	CORE	N	29	40	18
1548	PDSM	B	Y	31	14	4
1552	PDSM	F	L	27	14	7
1586	no traces	F	N	38	33	9
1595	used	F	L	27	21	5
1616	no traces	F	N	32	22	9
1625	used	B	L	29	14	4
1650	used	F	Y	19	26	10
1653	no traces	B	N	22	10	5
1662	PDSM	F	Y	27	23	10
1665	techno	F	N	15	25	3
1666	PDSM	CORE	N	31	22	10
1692	no traces	F	Y	23	15	10
1706	NP	F	N	20	14	8
1722	PDSM	B	Y			
1760	PDSM	F	L	24	17	4
1768	PDSM	CORE	N	36	27	11

Number	TYPE	Blank	Retouched	L	B	T
-----	-----	-----	-----	---	---	---
1770	used	F	Y	29	19	7
1771	used	F	Y	34	18	4
1777	used	F	Y	18	21	6
1778	PDSM	F	Y	21	21	6
1787	no traces	F	Y	14	8	3
1800	techno	F	Y	26	14	12
1801	used	F	L	24	13	4
1818	PDSM	B	L	16	6	4
1827	techno	B	Y	24	10	5
1838	PDSM	B	Y			
1865	used	B	Y	14	3	2
1886	used	F	Y			
1891	used	B	Y			
1900	PDSM	B	Y	10	4	2
1901	used	F	Y	24	31	13
1924	techno	F	Y	14	8	2

Appendix C4

Kissonerga Mosphilia basic data

Refer to appendix B for information on recording system

All the pieces interpreted as "used" are described individually, giving a brief textual description of the more significant features to allow quick assessment of these pieces. More detailed information is kept on archive in the Dept of Archaeology, University of Edinburgh.

As this work simply represents an initial trial study of material, individual piece by piece sketches are not given here.

Following this piece by piece information are various summary tables detailing the complete sample.

Ref: KM007 Type: MISC RET, Blank: BLADE, Mat: BF,
Dim: 44x28, Qual: GOOD, Cond: FRESH

Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A, Edge Angle: acute

Traces:

Side a, both faces very similar: common clustered medium step terminating shallow scars with snaps. Associated with linear polish along edge. Polish is smooth domed, allover, developed, bright, with sharp edges and common small circular pits. Associated with random short deep fine striations. Also with patchy polish away from edge. polish is smooth domed (reticulated), partially linked, variable, with gradual edges.

Interpretation: side a used, long motion, med hard material

Comments: pos wood

Ref: KM016, Type: MISC RET, Blank: FLAKE, Mat: GC
Dim: 26x15x5, Qual: EXC, Cond: FRESH

Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A, Edge Angle: thick

Traces:

Edge damage not possible on ventral because of retouch, edge row looks bidirectional.

Dorsal side b: occasional clustered large feather terminating deep scars.

Side b, both faces: polish A: patchy linear polish along the edge and around scar ridges. Polish is smooth domed, partially linked, variable, with common minute irregular pits. Polish B: patchy polish on edge. Polish is smooth domed, allover, developed, with sharp edges and no internal features. Is part of A

Interpretation: side b used, long (possibly bidirectional) motion, soft material

Ref: KM020, Type: DENTIC, Blank: FLAKE, Mat: BF,
Dim: 85x52, Qual: EXC, Cond: FRESH

Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A, Edge Angle: acute

Traces:

Side b, both faces very similar: edge damage very difficult, denticulation possibly made during use.

Polish in restricted patches (partially restricted narrow linear along edge) on and away from edge. Polish is smooth domed, partially linked, developed, with sharp edges and common variable irregular pits. Associated are parallel medium deep fine striations. Also rough reticulated polish in patches.

Interpretation: side b used, long motion, med hard material

Comments: wood or bone, heavy sawing motion judging from the denticulation effect

Ref: KM041, Type: "USED", Blank: FLAKE, Mat: GMC
Dim: 91x41, Qual: MED, Cond: FRESH

Material: Grain: M Homog: H Crys: O Topo: F Fissures: A, Edge Angle: thick

Traces:

Dorsal side a: numerous clustered deep step terminating medium scars with snaps, associated with restricted patches of polish on extreme edge. Polish is rough reticulated, scattered.

Ventral side a: minor edge damage, associated with patches of polish along edge. Polish is smooth domed, partially linked, with fairly sharp edges and common small irregular pits.

Interpretation: side a used, transverse motion, med hard material

Ref: KM042, Type: BURIN, Blank: FLAKE, Mat: BMC
Dim: 37x34x10, Qual: MEDCond: FRESH

Material: Grain: M Homog: V Crys: O Topo: F Fissures: A, Edge Angle: thick

Traces:

Side a, ventral face: numerous clustered medium, and common clustered large, mostly step terminating mixed scars, associated with a restricted narrow linear polish along the edge. Polish is smooth domed, allover, developed, with sharp edges and no internal features.

Interpretation: side b used, opp use, transverse motion, hard material

Comments: burin like facet, opposite denticulation used

Ref: KM044 Type: SCRAPER Blank: BLADE Mat: DBC
Dim: 33x14 Qual: MEDIUM Cond: FRESH

Material: Grain: M Homog: H Crys: O Topo: F Fissures:
A Edge Angle: thick

Traces:

Problem piece. Covered overall with a general gloss,
appears most marked at distal end. At same end
possible edge damage, but made problematic by
retouch effects

Interpretation: pos opp use
Comments: difficult

Ref: KM048 Type: MISC RET Blank: BLADE Mat: DBF
Dim: 57x22 Qual: GOOD Cond: FRESH

Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A Edge Angle: thick

Traces:

edge damage not recorded because of retouch

Side a, both faces: patchy polish along edge. Polish
is rough reticulated, scattered, poor. Also
restricted patches along edge, with some linearity
at 75° to parallel to edge. Polish is smooth domed,
partially linked, with gradual edges and occasional
small irregular pits. Associated with parallel short
deep fine striations.

Interpretation: side a used, long motion, med hard
material

Ref: KM074 Type: SCRAPER Blank: BLADE Mat: GMC
Dim: 37x18x8 Qual: MED Cond: FRESH

Material: Grain: M Homog: V Crys: O Topo: F Fissures:
A Edge Angle: medium

Traces:

edge damage not recorded on dorsal because of
retouch

Ventral side a: rare scattered medium mostly feather
terminating deep scars and rounding

Side a both faces: broad spread along edge. Polish
is smooth domed, all over, intense, bright, variable,
with occasional large irregular pits. Not in scars
on ventral, in retouch scars on dorsal. Associated
with parallel medium deep striations.

Interpretation: side a used, probably long motion, medium soft material

Comments: original confusion on motion caused by retouch

Ref: KM111 Type: NOTCH Blank: SPALL Mat: BF

Dim: 40x11 Qual: GOOD Cond: FRESH

Material: Grain: F Homog: H Crys: A Topo: F Fissures:

A Edge Angle: thick point

Traces:

dorsal tip - notch = edge damage formed during use

Polish goes completely round tip. Patchy, linear (perpendicular to long axis) polish on and away from edges. Polish is smooth reticulated, partially linked, developed, variable, with gradual edges and no internal features. Associated with perpendicular short deep fine frequent striations.

Interpretation: point used, drill, hard material

Comments: notch is created by use. Matches experimental pieces used to drill ceramics

Ref: KM120 Type: BURIN Blank: BLADE Mat: BF

Qual: EXC Cond: FRESH

Material: Grain: F Homog: H Crys: A Topo: F Fissures:

A Edge Angle: thick

Traces:

Dorsal side b; frequent clustered small to minute step terminating deep scars, associated with restricted narrow linear polish along edge. Polish is rough reticulated, poor.

Ventral side b; occasional clustered small variable termination deep scars associated with patchy linear polish along edge. Polish is smooth reticulated, partially linked, intense, bright, with sharp edges and no internal features.

Interpretation: side b used, transverse motion, hard material

Comments: burin edge used

Ref: KM121 Type: SICKLE Blank: BLADE Mat: BF
Dim: 25x13 Qual: EXC Cond: FRESH

Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A Edge Angle: medium

Traces:

Ventral side a: numerous clustered large feather
terminating deep scars and rounding.

Side a, both faces: broad spread along and away from
edges. Polish is smooth flat, allover, intense,
bright, variable, with gradual edges and numerous
large to small irregular pits. Associated with
parallel short shallow to medium narrow to medium
striations

Interpretation: side a used, long motion
Comments: as sickle

Ref: KM130 Type: ED Blank: FLAKE Mat: RC
Dim: 47x27x12 Qual: MED Cond: FRESH
Material: Grain: M Homog: V Crys: A Topo: F Fissures:
A Edge Angle: thick

Traces:

Dorsal side a: frequent clustered and layered large
to medium mostly step terminating deep scars,
associated with no polish.

Ventral side a: no edge damage. Broad patchy polish
on and away from edge. Polish is smooth domed,
allover, developed, bright, with fairly sharp edges
and common variable irregular pits.

Interpretation: side a used, transverse motion, hard
material
Comments:

Ref: KM135 Type: SICKLE Blank: BLADE Mat: GMC
Qual: MED Cond: FRESH

Material: Grain: M Homog: H Crys: A Topo: F Fissures:
A Edge Angle: medium

Traces:

Distal end, both faces virtually identical: numerous
clustered large to small mostly step terminating
deep scars, associated with a restricted patchy
(linear) polish along the edge. Polish is smooth
reticulated, partially linked, intense, bright, with
gradula edges and numerous small circular pits.
Associated with perpendicular medium deep narrow
striations.

Interpretation: distal end used, probably long motion,
hard material
Comments: striations conflict with rest of evidence for
motion

Ref: KM155 Type: "USED" Blank: BLADE Mat: BF
Qual: EXC Cond: FRESH

Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A Edge Angle: thick

Traces:

dorsal side b: occasional scattered small step
terminating deep scars, associated with small
patches along edge. Polish is rough reticulated,
scattered, poor with soft edges and no internal
features.

Interpretation: pos opp use
Comments: minimal traces

Ref: KM179 Type: NOTCH Blank: FLAKE Mat: BC
Dim: 34x39x14 Qual: GOOD Cond: FRESH

Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A

Edge Angle: thick

Traces:

Edge damage not recorded because of retouch

Polish on distal: patchy (linear) polish along edge.
Polish is smooth domed, partially linked, fairly
sharp edges with occasional small circular pits.
Associated with perpendicular short deep fine
striations. Striations concentrated on the centre of
the notch.

Interpretation: distal end used, transverse motion,
ventral leads
Comments: notch used

Ref: KM184 Type: "USED" Blank: FLAKE Mat: BF
Dim: 65x61 Qual: MED Cond: FRESH

Material: Grain: M Homog: H Crys: A Topo: F Fissures:
A Edge Angle: acute

Traces:

Side b, both faces: numerous clustered medium mostly
step terminating deep scars, associated with patchy

polish along edge. Polish is rough reticulated, scattered, poor with gradual edges and no internal features.

Interpretation: pos minor use (long) on hard material
Comments: could be NUW, not entirely convincing

Ref: KM191 Type: SICKLE Blank: BLADE Mat: RC
Dim: 33x19 Qual: GOOD Cond: FRESH

Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A Edge Angle: medium

Traces:

Side b, both faces virtually identical: frequent scattered large mixed termination shallow scars associated with patches of polish along and away from the edge. Polish is smooth flat reticulated, partially linked, intense, bright, variable, with gradual edges and occasional to frequent small mixed pits. Associated are parallel short shallow fine striations.

Interpretation: side b used, long motion, med hard material

Comments: not the norm for sickle wear, looks more like a harder material, eg wood

Ref: KM194 Type: SCRAPER Blank: FLAKE Mat: GMC Dim:
88x53x14 Qual: GOOD Cond: FRESH

Material: Grain: C Homog: H Crys: C Topo: F Fissures:
A

Edge Angle: medium

Traces:

Dorsal side b: regular clustered large to small mostly step terminating scars associated with a patchy broad spread along and away from the edge. Polish is smooth domed, partially linked, developed, bright, with sharp edges and common medium to small circular pits. Also a patchy linear polish away from but parallel to the edge. Polish is smooth domed and invasive, partially linked, with sharp edges and common medium circular pits.

Ventral side b: frequent clustered large to small mostly step terminating mostly deep scars associated with a patchy polish on and away from the edge. Polish is smooth domed and invasive, partially linked, developed, with fairly sharp edges and occasional medium circular pits.

Interpretation: side b used, long motion, medium hard material

Comments: retouch used as finger rest, + minor backing on side a

Ref: KM211 Type: MISC RET Blank: BLADE Mat: BF
Dim: 58x29 Qual: GOOD Cond: FRESH

Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A Edge Angle: medium

Traces:

Side b, both faces; common clustered medium mostly step deep scars with snaps, associated with broad spread of along and away from edge. Polish is rough reticulated, scattered, poor with gradual edges and no internal features. Also with restricted patches within that polish. Polish is smooth domed, partially linked, developed, with gradual edges and occasional small circular pits.

Interpretation: side b used, long motion, hard material
Comments:

Ref: KM229 Type: MISC RET Blank: BLADE Mat: YF
Dim: 54x12x6 Qual: EXC Cond: FRESH

Material: Grain: F Homog: H Crys: A Topo: F Fissures:
A

Edge Angle: thick

Traces:

Edge damage difficult to record because of retouch.

Dorsal ridge: frequent clustered small to minute step terminating deep scars associated with patchy polish along ridge. Polish is smooth flat, partially linked, developed, bright, with abrupt edges and occasional variable irregular pits. Associated with random medium broad striations.

Interpretation: dorsal ridge used, transverse motion, hard material

Comments: has to be hard to damage stable dorsal ridge, planing motion

KM242, Used flake, Dim: 64x35, brown flint, good, fresh
Edge Angle: acute to medium

Traces:

All traces on side b, both faces. Frequent clustered medium step terminating deep scars with crushing.

Broad spread of polish along edge. Smooth reticulated, widely variable, associated with striations at 750.

Interpretation: side b used, long motion

KM245, "used"flake, dim: 96x63, black flint, good, fresh
Edge Angle: variable

Traces:

All traces on side b, both faces: frequent clustered large to medium step terminating deep scars with snaps and crushing. Restricted narrow linear polish along edge. Reticulated, scattered, bright, with no internal features.

Interpretation: side b used, long motion, hard material.

KM273, Misc ret, flake, dim: 28x29x8, grey chert, good, fresh
Edge Angle: thick

Traces:

No edge damage distinguishable from retouch. Patchy polish along dorsal side b. Polish is smooth domed, allover, developed, bright, with gradual edges and occasional minute circular pits. Associated with retouch scars.

Interpretation: pos use of side b.
Comments: difficult to interpret

KM283, sickle blade

Traces:

side a, both faces: regular clustered deep large mostly step terminating scars. Restricted linear polish along edges. Polish is smooth reticulated (with occasional flat patches), intense to poor, widely variable. Associated with parallel short shallow fine to narrow frequent striations.

Interpretation: side a used, long motion, hard material
Comments: unlike a "normal" sickle gloss

KM291: sickle, truncated blade, dim: 33x19, red chert, good, fresh
Edge Angle: medium

Traces:

All traces on side b, both faces: frequent scattered, variable, mostly feather terminating deep

scars. Less frequent on dorsal. Restricted patches of polish along the edge. Polish is smooth reticulated, with flat patches, intense, bright, with frequent variable irregular pits. Associated with parallel med shallow fine to narrow striations.

Interpretation: side b used, long motion

Comments: polish looks like hard material worked, edge damage suggests soft material, does not look like classic sickle gloss

KM305, sickle, flake

Traces:

All traces on side a, both faces: numerous clustered large mostly feather terminating deep scars with snaps. Broad spread of polish along edge. Polish is smooth reticulated with patches of flat, intense, bright, variable, with frequent small to minute circular pits. Associated with parallel medium, medium, fine striations.

Interpretation: side a used, long motion, polish suggests harder material than edge damage.

Comments:

KM325: scraper, flake, dim: 32x26x5, green chert, exc, fresh

Edge Angle: thick

Traces:

Side b, dorsal face: edge damage not recorded because of retouch. Restricted narrow linear polish along edge. Polish is smooth domed, all over, with no internal features, forms an edge bevel. Is clearly post-retouch.

Interpretation: side b used, transverse motion

Comments: scraper used as scraper

KM326: sickle blade, dim: 35x15, grey banded chert, good, fresh, medium edge

Traces:

Side a, both faces: Patchy spread of polish along and away from edge. Polish is smooth reticulated, scattered.

Interpretation: side a used, long motion, hard material

Comments: not at all like sickle gloss

KM354: "used" flake, dim: 66x40, brown flint, good, fresh, medium edge

Traces:

Both faces side b: Frequent clustered and layered large step terminating deep scars, stepped onto each other. vary patchy polish along edge. Polish is reticulated, scattered, developed.

Interpretation: side b used, probably impact, hard material

Comments: wood choppin?

KM410: scraper, flake, dim: 66x55x14, red chert, exc, fresh, thick edge

Traces:

Distal, ventral face; occ clustered small mostly step terminating mostly deep scars. Patchy polish away from edge. Smooth domed, allover, developed, bright, with frequent small circular pits. Also patchy polish on edge. smooth domed, partially linked, with common small irregular pits. Also restricted narrow linear polish along edge. Smooth domed, developed with no internal features. Also patchy polish on interior. Polish is smooth domed allover developed bright with occasional small circular pits.

Distal, Dorsal face: restricted patchy polish along edge. Polish is smooth domed and invasive, partially linked, developed, with occasional small circular pits.

Interpretation: distal end used, transverse motion, medium material

Comments: scraper used as scraper, low angle of working = planing

KM437: misc ret, flake, dim 30x20, thick edge

Traces:

Edge damage not recorded because of retouch. Side a has poorly developed ares of reticulated polish on both faces

Interpretation: side a opp use?, long motion

Comments: very poor, but rest of piece fresh so suggests these are use traces

KM445: sickle blade, med, fresh

Traces:

Edge damage unclear: regular scarring along side b, dorsal face looks like deliberate retouch
Side b, both faces: restricted patches along edge of smooth reticulated variable polish associated with parallel short shallow fine striations. Polish is concentrated on high points of microtopography

Interpretation: side b used, long motion, hard material

KM446: "used" blade, dim: 82x31, black flint, good, fresh, acute edge.

Traces:

Side b, both faces: frequent clustered large to medium step terminating deep scars with snaps and crushing. Patchy spread of polish along edge. Polish is smooth reticulated, variable, concentrated on high points of microtopography

Interpretation: side b used, long motion, hard material

KM449: sickle, flake, burnt

Traces:

Side a, both faces: Edge damage difficult to record because of retouch, frequent clustered medium deep step terminating scars. Patches of smooth reticulated polish along edge, developed, with frequent minute circular pits. Associated with parallel short shallow fine striations.

Interpretation: side a used, long motion, prob hard material

Comments: burning causes problems

KM450: burin, flake, dim: 45x27x9, mottled chert, medium, fresh, with thick edges.

Traces:

Numerous patches of polish all over piece, cause serious problems.

Dorsal side b: frequent clustered large to small mostly step terminating mostly deep scars, associated with a restricted narrow linear edge bevel.

Ventral side b: patchy polish on and away from edge. Polish is smooth flat, scattered, intense, with frequent 45° internal linearity. Associated with random striations.

Interpretation: side b used, probably transverse
Comments: Polish on ventral problematic

KM481: notch, flake, dim: 19x28, mottled chert, good, fresh, with thick edges

Traces:

Edge damage not possible on dorsal because of retouch, no edge damage on ventral.
Ventral in notch: smooth flat linear perpendicular developed polish. Associated with perpendicular short broad striations.

Interpretation: notch (side b) used, transverse motion, hard material

KM492: misc ret, blade, brown chert, good, fresh

Traces:

Edge damage not possible on ventral because of retouch, on ventral side b: frequent clustered, small, mixed termination, deep scars with snaps.
Side b, both faces: restricted narrow linear polish along edge. Polish is rough reticulated, scattered, poor. No internal features.

Interpretation: side b used, long motion.
Comments: minimal but clear traces

KM514: scraper, flake, dim: 36x39x12, red chert, exc, fresh, with thick edges

Traces:

Side a: edge damage not recorded on dorsal because of retouch. on ventral occasional clustered medium to small step terminating deep scars, associated with a restricted narrow linear polish along the edge, forming an edge bevel. On dorsal a restricted patchy smooth domed polish, partially linked, developed, variable, with no internal features.

Interpretation: side a used, transverse motion, hard material

Comments: classic scraper wear, scraper used as scraper, only small part of retouched perimeter used.

KM521: misc ret (denticulate), flake, dim: 27x37x8, mottled chert, medium, fresh, medium edge.

Traces:

Side B: edge damage impossible on dorsal because of retouch, only rare scars on ventral. Patchy polish

along edge, both faces. polish is smooth domed, partially linked, developed, with no internal features. Also a restricted patchy smooth flat polish.

Interpretation: side b used, long motion, medium hard material.

KM563: edge damaged, flake, dim: 63x27x8, grey chert, exc, fresh, point

Traces:

Concentrated around point, all faces and dorsal ridges: frequent clustered and layered, large to medium, mixed termination, mostly deep scars. Associated with (at tip) a restricted patchy polish on the edge. Polish is smooth domed, partially linked, with occasional minute circular pits. Away from tip, a patchy polish away from the edge. Polish is smooth domed, all over, developed, with occasional small circular pits. Associated with short deep parallel striations.

Interpretation: point used, long or circular, motion
Comments: not entirely clear how used. Presence of wear on all faces and edge damage on dorsal ridges as well as edges suggests rotary motion, but striations suggest long motion

KM569: notch, flake, dim: 29x24x9, grey chert, good, fresh, thick edges.

Traces:

In notch (side b): no edge damage recorded, but impossible on dorsal because of retouch. On dorsal linear polish perpendicular to edge, all on interior away from edge. Associated with striations, also perpendicular to edge.

Interpretation: Notch (side b) used, transverse motion
Comments: no features visible in notch on edge - this is because the topography of the piece prevented the microscope from being positioned to look into notch. Suggested interpretation of something dragged through the notch.

KM575: scraper frag, blade, dim 28x6, black flint, exc, fresh. thick edges.

Traces:

On retouch on dorsal smooth invasive polish, partially linked, restricted to edge. Concentrated

near former distal end. restricted linear edge bevel
on opposed ventral surface.

Interpretation: side a used, transverse motion, medium
soft material

Comments: scraper used a scraper, break during use

KM577: misc ret (denticulate), flake, dim: 28x15x7, green
chert, good, fresh, thick edges.

Traces:

No edge damage visible, on distal ventral very
restricted narrow linear polish along edge.

Interpretation: pos opp use of distal notched end

Comments: possibly transverse. Rest of piece very fresh,
not NUW traces, if not use then techno feature associated
with manufacture of notches, but marked linearity
suggests use.

KM606: scraper, flake, dim: 38x31x14, grey chert,
excellent, fresh, point.

Traces:

Numerous unpatterned traces accross piece,
especially on ventral surface. Around point on
corner of distal and side a much edge damage, also
on dorsal ridge at this point. Edge damage is common
clustered medium to small mostly step terminating
mostly deep scars.

Interpretation: opp use of point

Comments: dispersed features associated with retouch,
retouch unused. No polish associated with edge damage on
point, but concentration and presence on dorsal ridge as
well as edges suggests use.

Kmos, pieces with traces

N	TYPE	MOTION	HARD	MATERIAL	FUNCTION	NOTES
1	USED	TRANSV	HARD		SCRAPE	
2	OPP USE	LONG			CUT	
4	OPP USE	TRANSV	MEDIUM	WOOD	SHAVE	
6	USED	LONG	HARD		CUT	
11	USED	TRANSV	MED H	WOOD	SHAVE	
12	USED	TRANSV	MEDIUM	S WOOD	SHAVE	
7	USED	LONG B	MED H	WOOD	SAW	
16	USED	LONG B	SOFT		SAW	
20	USED	LONG	MED H	BONE	CUT	
41	USED	TRANSV	MED H		SHAVE	
42	OPP USE	TRANSV	HARD			
44	OPP USE					(AWT)
48	USED	LONG	MED H		CUT	
74	USED	?	MED-S			
111	USED	DRILL	HARD	POT	DRILL	
120	USED	TRANSV	HARD		SHAVE	
121	USED	LONG			SICKLE	
130	USED	TRANSV	HARD			
135	USED	LONG			SICKLE	
155	OPP USE					=PDSM?
179	USED	TRANSV	MED			
184	OPP USE					=PDSM
191	USED	LONG	MED	WOOD?	SICKLE?	
194	USED	LONG B	MED	(WOOD)	SAW	
211	USED	LONG	HARD			
229	USED	TRANSV	HARD		PLANE	
242	USED	LONG	MED		CUT	
245	USED	LONG	HARD			
273	USED?					DIFFICULT
283	USED	LONG	HARD		SICKLE?	
291	USED	LONG	MED S		SICKLE?	
305	USED	LONG	MED S		SICKLE?	
325	USED	TRANSV	MED			LIGHT USE
326	USED	LONG	MED/MH	WOOD/	SICKLE++	2 USES?
354	USED	IMPACT	HARD	WOOD?	CHOP	CHOPPING
410	USED	TRANSV	MED		PLANE?	LOW ANGLE
437	OPP USE	LONG				PDSM
445	USED	LONG	HARD			
446	USED	LONG	HARD			
449	USED	LONG			NOT SICKLE	BURNT GLOSS
450	USED	TRANSV				
481	USED	TRANSV	HARD			IN NOTCH
492	USED	LONG				
514	USED	TRANSV	HARD		SCRAPER	
521	USED	LONG	MED H			
563	USED	LONG	MED S			POINT?
569	USED	TRANSV	HARD			NOTCH USED
575	USED	TRANSV	MED S		SCRAPER	
577	OPP USE					MARGINAL
606	OPP USE	POINT				NOT SCRAPER

KMOS, sample for functional analysis

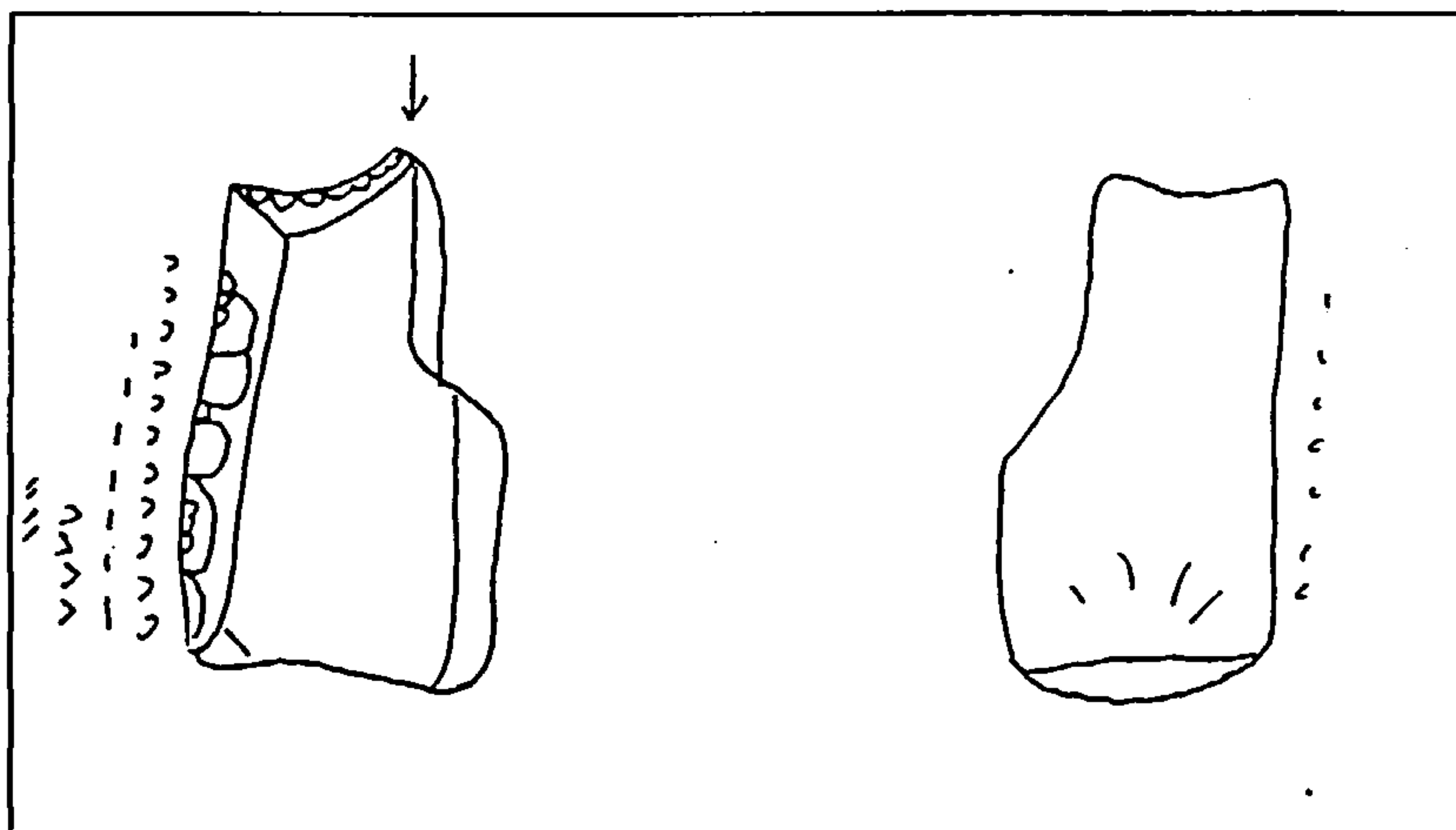
ID	N	TYPE	TOOL	BLANK
-----	-----	-----	-----	-----
KM	1	USED	UNRETOUCHED	F
KM	2	OPP USE	UNRETOUCHED	F
KM	3	UNUSED	UNRETOUCHED	F
KM	4	OPP USE	UNRETOUCHED	B
KM	5	AWT	UNRETOUCHED	B
KM	6	USED	UNRETOUCHED	B
KM	7	TECHNO	UNRETOUCHED	F
KM	8	AWT	UNRETOUCHED	F
KM	9	AWT	UNRETOUCHED	F
KM	10	UNUSED	UNRETOUCHED	F
KM	11	USED	UNRETOUCHED	F
KM	12	USED	UNRETOUCHED	B
KM	13	UNUSED	UNRETOUCHED	F
KM	14	AWT	UNRETOUCHED	F
KMOS	7	USED	RET FLAKE	F
KMOS	12	UNUSED	RET FLAKE	F
KMOS	16	USED	RET BLADE	F
KMOS	19	UNUSED	RET FLAKE	F
KMOS	20	USED	DENTICULATE	F
KMOS	21	UNUSED	MULTI MIX	F
KMOS	41	USED	USED BLADE	B
KMOS	42	OPP USE	DENTICULATE	F
KMOS	44	OPP USE?	SCRAPER NOSE	B
KMOS	46	UNUSED	BURIN ON BREAK	B
KMOS	48	USED	RET FLAKE	B
KMOS	50	UNUSED	RET FLAKE	F
KMOS	51	UNUSED	RET CHIP	F
KMOS	56	UNUSED	RET BLADE	B
KMOS	71	AWT	RET CHIP	F
KMOS	72	NP	BURIN DIHEDRAL	F
KMOS	74	USED	USED BLADE	B
KMOS	88	UNUSED	SCRAPER END	F
KMOS	111	USED	NOTCH	B
KMOS	120	USED	BURIN ON BREAK	F
KMOS	121	USED	SICKLE BLADE	F
KMOS	123	UNUSED	BURIN ON BREAK	F
KMOS	127	UNUSED	USED FLAKE	F
KMOS	130	USED	RET BLADE	F
KMOS	135	USED	SICKLE BLADE	F
KMOS	142	UNUSED	RET FLAKE	F
KMOS	145	AWT	MULTI MIXED	F
KMOS	155	OPP USE?	USED BLADE	B
KMOS	164	UNUSED	RET CHIP	F
KMOS	179	USED	SCRAPER HOLLOW	F
KMOS	184	OPP USE?	USED FLAKE	F
KMOS	186	UNUSED	SCRAPER ROUND	F
KMOS	191	USED	SICKLE BLADE	B
KMOS	194	USED	SCRAPER END	F
KMOS	211	USED	RET FLAKE	F

ID	N	TYPE	TOOL	BLANK
-----	-----	-----	-----	-----
KMOS	229	USED	DENTICULATE	B
KMOS	230	UNUSED	BURIN ON BREAK	F
KMOS	242	USED	USED FLAKE	F
KMOS	245	USED	USED FLAKE	F
KMOS	266	AWT	BURIN ON BREAK	B
KMOS	272	UNUSED	RET BLADE	B
KMOS	273	USED?	DENTICULATE	F
KMOS	283	USED	SICKLE BLADE	B
KMOS	291	USED	SICKLE BLADE	B
KMOS	305	USED	SICKLE BLADE	F
KMOS	325	USED	RET FLAKE	F
KMOS	326	USED	SICKLE BLADE	B
KMOS	342	UNUSED	RET BLADE	B
KMOS	354	USED	USED FLAKE	F
KMOS	357	AWT	RET FLAKE	F
KMOS	365	AWT	RET FLAKE	F
KMOS	393	UNUSED	SICKLE BLADE	F
KMOS	399	AWT	BORER	F
KMOS	403	AWT	USED FLAKE	F
KMOS	410	USED	SCRAPER END	F
KMOS	436	UNUSED	RET FLAKE	F
KMOS	437	OPP USE?	RET CHIP	F
KMOS	445	USED	SICKLE BLADE	B
KMOS	446	USED	USED BLADE	B
KMOS	449	USED	SICKLE BLADE	F
KMOS	450	USED	BURIN ON BREAK	F
KMOS	451	AWT	NOTCH	F
KMOS	481	USED	NOTCH	F
KMOS	487	AWT	RET FLAKE	F
KMOS	489	TECHNO	DENTICULATE	F
KMOS	492	USED	RET CHIP	F
KMOS	512	UNUSED	RET BLADE	F
KMOS	514	USED	SCRAPER ROUND	F
KMOS	521	USED	DENTICULATE	F
KMOS	539	AWT	USED BLADE	B
KMOS	558	UNUSED	BURIN ON BREAK	B
KMOS	562	UNUSED	RET FLAKE	F
KMOS	563	USED	RET BLADE	B
KMOS	569	USED	NOTCH	F
KMOS	575	USED	SCRAPER FRAG	F
KMOS	577	OPP USE?	NOTCH	F
KMOS	582	AWT	RET CHIP	F
KMOS	606	OPP USE?	SCRAPER DENT	F
KMOS	613	UNUSED	RET FLAKE	F

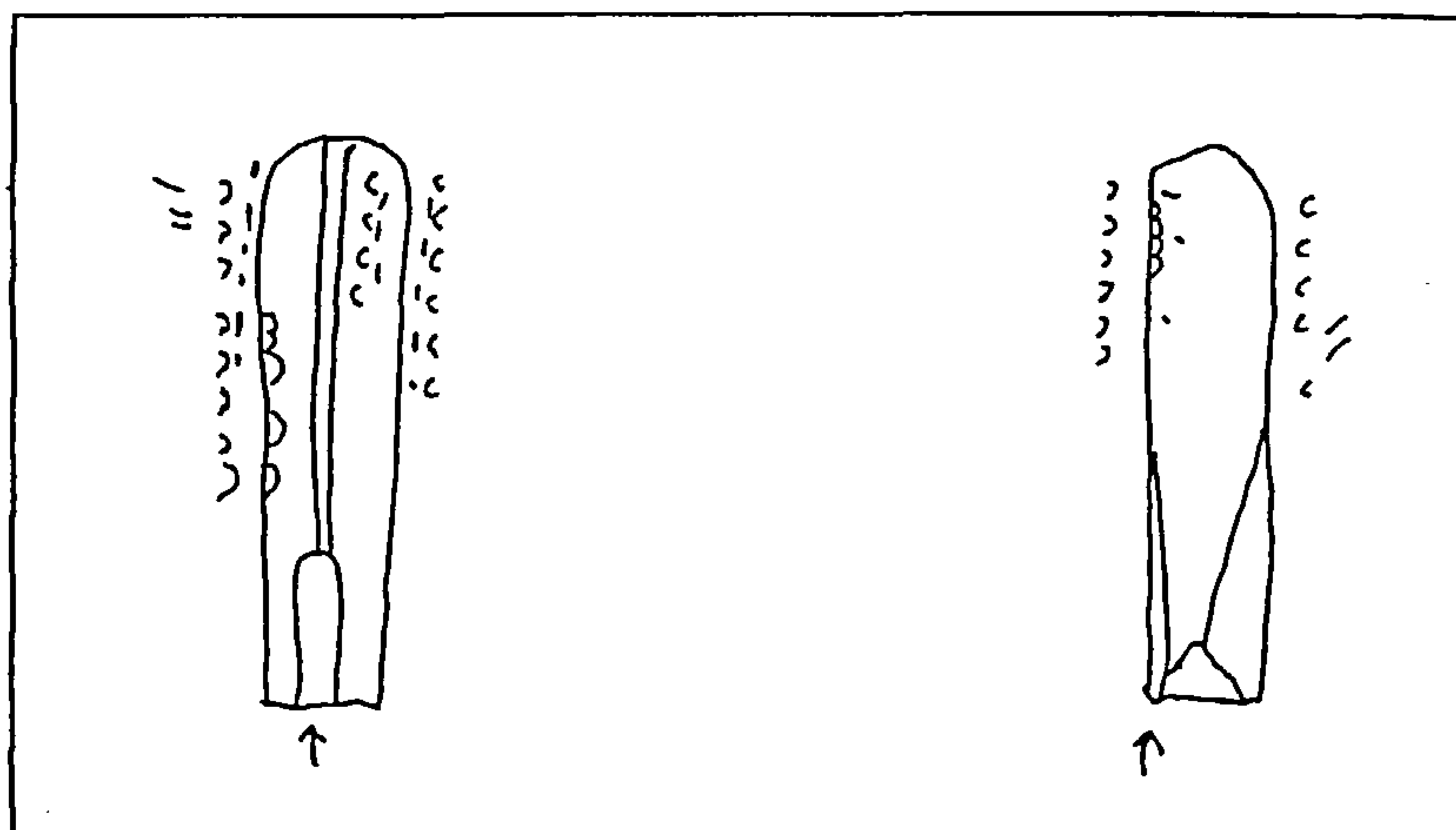
Appendix C5

Jebel Naja

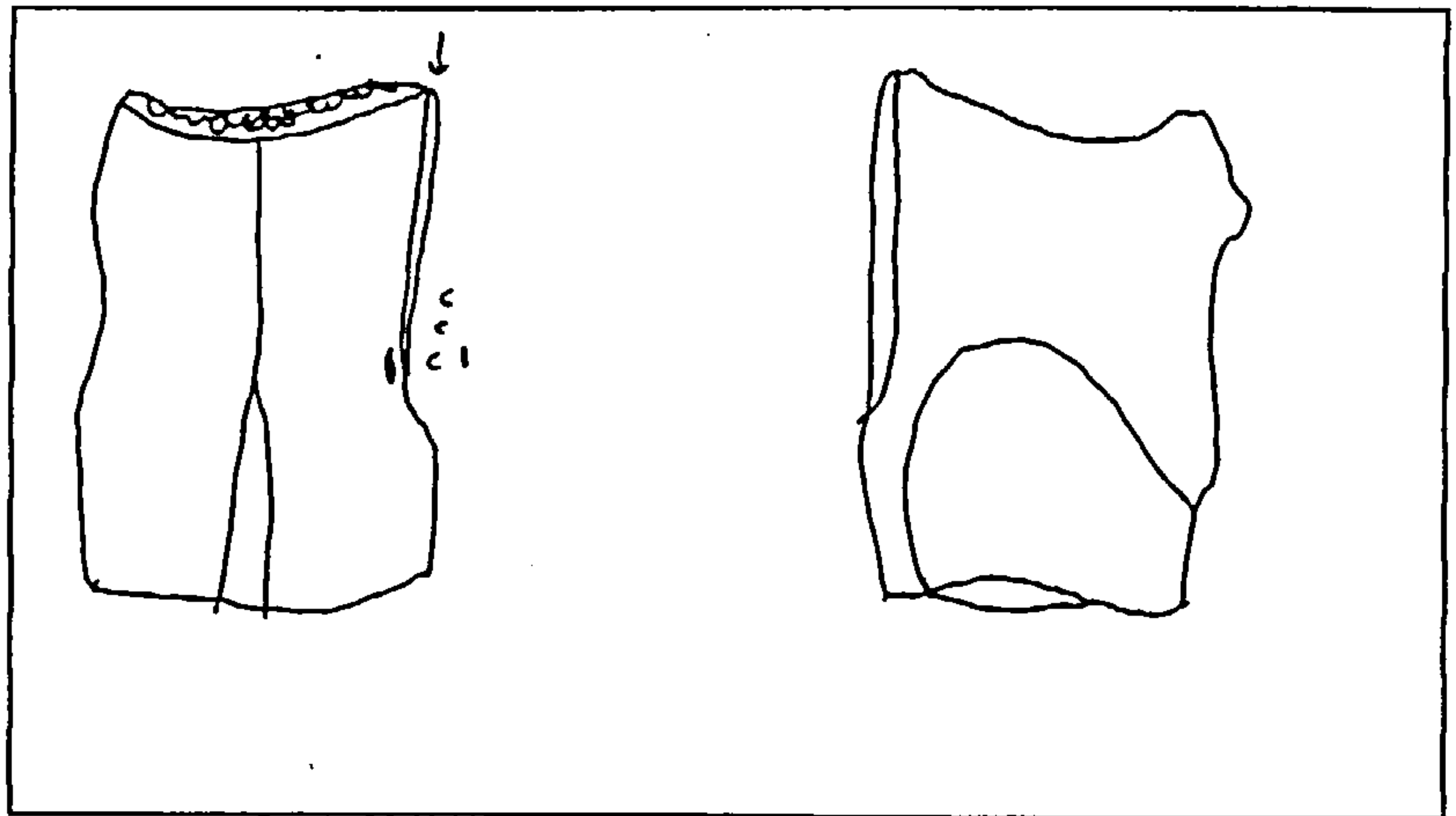
Only a very small sample of pieces from Jebel Naja were examined. As the purpose of the analysis was to examine the function of the burins, only those burins with possible wear traces are listed here. It is hoped that this investigation of burin function can be extended, and that the remaining relevant information can be presented in that context.



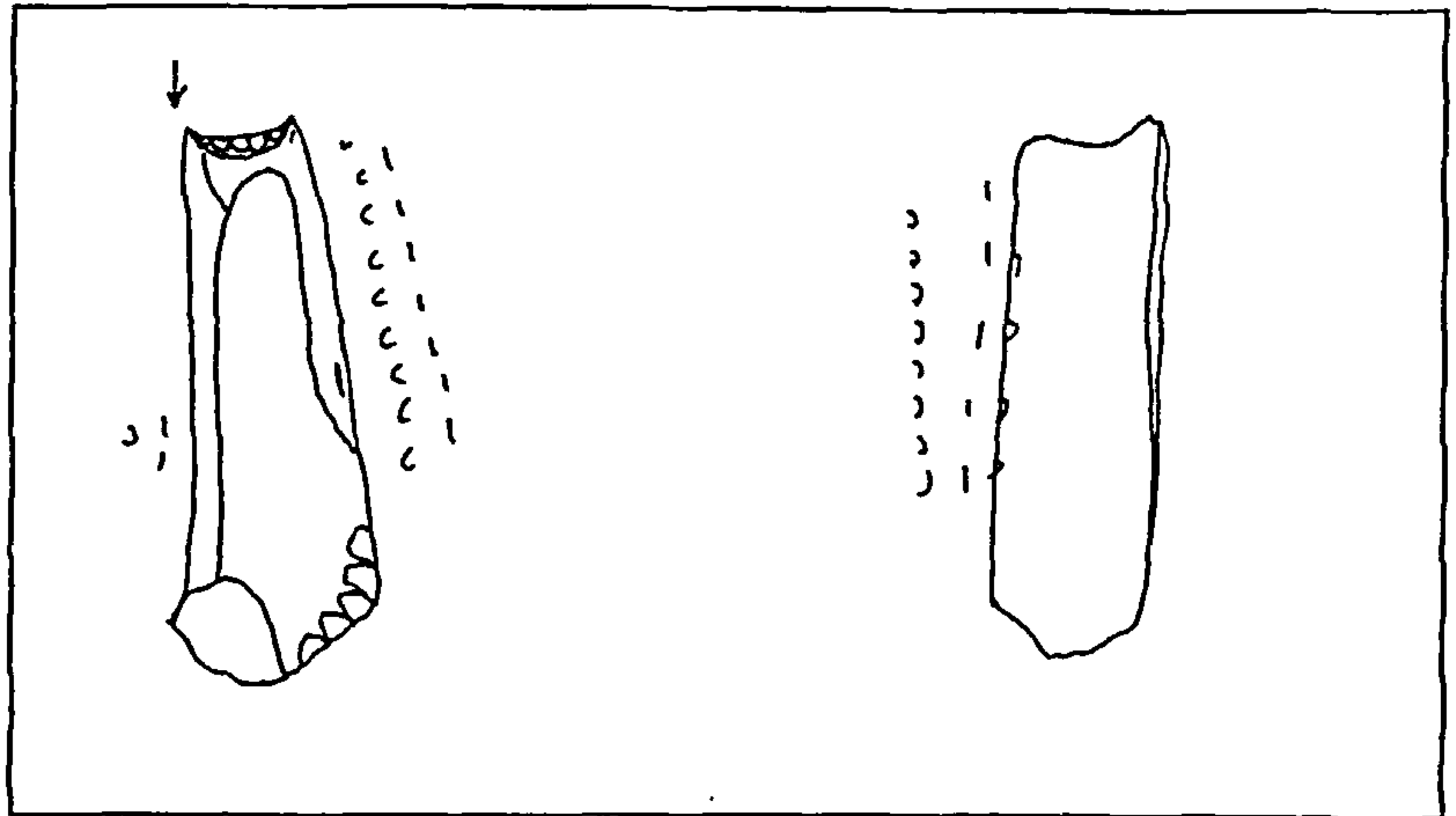
Concentration of features on side a, opposite burin removal, edge is thick with some flat retouch, features include frequent large mostly feather terminating scars layered with an edge row of small mostly step terminating scars with a spread of rough patchy polish on the dorsal face. The ventral aspect has rare small mostly step scars. On the extreme edge is a rounded smooth polish cut by the edge damage with short, shallow, narrow striations running at 45°. Occasional unpatterned features are scattered over the rest of the tool. Tool used.



Both edges and the dorsal ridge have, concentrated towards the distal end of the tool (opposite burin removals) clusters of edge damage. These consist of large scars with an edge row of small scars, both mainly step terminating. On the dorsal face these scars are predominantly on side a, on the ventral predominantly on side b. On both the dorsal and ventral faces, on the interior of the faces away from the edges are linear polishes running perpendicular to the edges of the tool. There is also a developed polish running in a narrow band along the edges associated with (and sometimes cut by) the scarring. The most reasonable explanation of these traces is a rotary motion in a predominantly anti-clockwise manner of the thick distal end. There are no traces on the burin facets where the piece would have been gripped/hafted.



At distal end of burin spall removal scar a cluster of large and medium feather terminating scars on dorsal face of burin. Associated with these are a restricted set of developed, bright, polish features, on both the dorsal face and the removal face. They are limited to the extreme edge. The original surface texture of the chert is obscured and the surface of the polish appears flat, or slightly domed, with abrupt edges.



1) At distal end of burin spall removal scar a cluster of large to medium, mostly feather terminating scars on the dorsal face of the burin. Associated with these is a restricted polish pattern, limited to the dorsal face only. The polish is developed and bright, invasive into the microtopography, with soft edges. It is patchy in its distribution.

2) On the medium to acute edge opposite the burin removals are frequent, bifacial, mostly shallow (generally deeper on the ventral face), mostly feather terminating scars. The bifacial distribution has a tendency to be alternating. The initiation and termination of the scars suggests a bi-directional force. Associated with these scars is a patchy spread of smooth invasive polish with soft edges, with frequent irregular pits, on both the extreme edge and away from the edge. On the raised parts of the microtopography within this polish is a more developed smooth domed polish with gradual edges, and common irregular pits. (Fig 2)

Appendix D

Image Processing

In an early attempt to resolve some of the problems of polish identification, image processing techniques were explored. In the light of recent work by Grace (1989) and Knutsson (1988), and the fact that the technique was abandoned as a practical tool in this study, this section is not an application of a method, but a critical review of the technique. One of the chief problems of polish identification is the description of the polish found. The subject of polish has already been discussed in the section on the general theory of functional analysis. It is however necessary to go over the points which would, in theory, make a digital image processing technique desirable. These points are presented as originally perceived. A discussion of the use of Image Processing in the light of the rest of this project will be given at the end of this section.

- 1) A consistent and accurate description of polish types is very difficult to achieve through the short descriptive phrases commonly used ("melting snow", etc). The use of photographs to support these descriptions is only a partial aid. An objective quantified description provided by an image processing technique would greatly reduce this problem.
- 2) In addition to the improved description of polishes, many of the problems of visual perception would be overcome.
- 3) The use of quantified objective data would allow the definition of separate polish types.
- 4) This data would allow an examination of how clearly polish types separate (or how much they overlap), and could potentially be used to subdivide polish types to allow greater certainty in interpretation, and possibly more detailed interpretation.
- 5) Once established, an image processing technique would allow some degree of automation to be used in functional studies using the "high power" method. This would increase the rate of work, without losing the detail that the "low power" method lacks.

Visual Perception

Before discussing the methods and techniques of image processing, it is necessary to outline the problems of visual perception. The human visual system is remarkably good. The range of light intensity to which the human eye can adapt is vast, being of the order of 10^{10} intensity levels from the scopic (dim light) threshold to the upper glare limit. The problem here lies in the fact that the eye cannot operate over this range simultaneously. In fact, at any one time, we only perceive in the order of 12 to 24 intensity levels. In the case of a complex image the eye adapts to an average level. The eye constantly adapts to different levels as it moves around the picture. This means that although we can easily make local subjective descriptions of "brighter" or "darker", it is impossible to quantify these in any way, and it is extremely difficult to make these comparisons beyond a restricted local area of an image.

Making accurate descriptions is worsened by the way the eye tends to "overshoot" around the border of zones of different intensity. This causes areas that are in reality of constant level to appear as though they have varying brightness. (Fig G.1)

General Theory of Image Processing

The basis of "Image Processing" techniques is the digitization of an image into an array of grey levels. Having once created this mathematical characterisation, the data can be manipulated in number of ways. What follows is a greatly simplified description of the method.

The Image

An image can be described as a two dimensional light intensity function: $f(x,y)$, where x and y denote spatial coordinates and where the value f at any point (x,y) is proportional to the brightness of the image at that point. Brightness is equivalent to grey level.

A digital image is one that has been made discrete in both its spatial coordinates and in brightness. This gives a matrix whose row and column indices identify a point in the image, and the corresponding matrix element value identifies the grey level at that point. The element is most commonly referred to as a pixel. As an example a monochrome TV has a 512×512 array with 128 grey levels.

Digitization

Before an image can be processed by a computer it must be first reduced to a discrete set of grey levels. These grey levels have to be sampled in a two-dimensional array of points. As the grey levels in the original image are continuous, this involves the quantization of grey levels. The grey levels in the image have to be divided into a fixed number of levels (K). For an image to appear like the original (for the purpose of visual appreciation) the number K has to be large, and the number of sampling points in the array ($M \times N$) has to be as large as possible. For the purposes of computer processing the numbers do not have to be as large, but care has to be taken not to reduce the numbers too far, or false information may appear. For example, reducing the number of grey levels (K) in an area of very gradual change will produce false contours in the quantized image as there will be large areas of one value, followed by an abrupt change to the next allowed K . Reducing the number of sample points ($M \times N$) too far will produce a checked effect. Solutions to these problems are very much a matter of trial and error, and vary depending on the type of image scene under analysis.

A range of equipment is available for digitization, including microdensitometers, flying spot scanners, image dissectors and TV camera digitizers. It has been common to have to work either from photographic negatives, transparencies or prints, although it is now becoming increasingly possible to use a frame grabber, taking images directly from the

original image. In the various tests done in this project images were taken from prints, transparencies, and, unfortunately only available in an initial preliminary study, through a frame grabber.

Grey Level Correction

It is impossible with the digitization process to produce directly comparable data between images. In the case of photographs being used as an intermediary stage, the variability in film, even of the same type, has been attested to (Grace 198?). Even discounting the problems with film, errors can arise from the lighting, microscope equipment and the digitisation method used. As a result some form of normalisation of data must be used. A commonly used method in digital image processing is histogram equalisation in which initial sampled grey levels are equalised. This method is useful for the normalisation of data, and is also a useful technique in image enhancement. (R.C.Gonzalez and P.Wintz 1977)

Image Enhancement

Practical applications of image enhancement techniques have not been used in microwear studies. However it is important to note that having once obtained the digitised image, it is frequently possible, through a wide variety of algorithms, to improve an image, removing blurred features and highlighting areas with insufficient contrast in the original for the perception of detail. Although these techniques could be of use in this area of study - for example, to increase edge contrast to facilitate edge detection - it was considered unwise to alter images for processing, as this could lead to error, but rather to concentrate on the production of high quality original images.

Techniques of analysis

Texture

While tone is based on the varying levels of grey in the elements of an image, texture is the spatial distribution of those grey tones. Texture is an innate property of all surfaces, containing information about the structural arrangement of those surfaces. The problem with image processing is to find a way of measuring that texture. It is assumed that texture information in an image is contained within the overall or "average" spatial relationship which the grey tones have with one another. A number of different techniques and methods have to be tried to see which technique best fits the material to be studied.

Edge Detection

An edge detection algorithm is designed to detect differences in amplitude between areas of comparatively smooth grey levels. Information can be gained from the number of boundaries in image, and this can produce a map of edges, similar in appearance to a contour map, showing areas of rapid change, and areas of little change. This technique can

be very useful as a way of illustrating changing surface texture over area, although may obviously suffer from the production of false contouring during image digitization.

Texture "Coarseness"

Gives information on homogeneity of image (ASM - angular second-moment feature), contrast, or local variation and correlation, a measure of grey tone linear dependencies. Grace et al use a method based on this principle (Grace et al 1988).

Other Methods

A range of other techniques exist. A useful quick check on the comparison of images, or portions of images, can be made by examining the grey level histograms, which provide a global view of the images. Measurements can be made for the connectivity of areas of similar texture, useful in the question of polish development, as areas of polish start to join up.

Analysis Process

Any process developed to study images, particularly in the initial trial stage, should include a number of different techniques. These act as a useful control on the information provided by each technique, and from the range of techniques tried it becomes possible to develop the methods that provide the most useful information. The various techniques do measure different properties, properties which together form the global generalised perception of image that the human visual system picks up. It is only through a period of testing that the techniques that isolate the important discriminating features in an image can be found.

As all image processing techniques involve the artificial manipulation and altering of an image, if any single test is used in isolation, there is a possibility that the results are more the product of that method than a representation of a real phenomena. Because of this, the best approaches using image processing techniques employ a suite of methods, partly to improve the resolution of analysis by finding the most suitable technique, but also to cross-check individual results.

Problems of Image Processing as applied to stone tool functional analysis

There is now a range of powerful methods to employ. There are however a number of serious problems, some general and some of particular relevance to the material studied in this paper.

Image Quality

It is obvious that even the most powerful analysis is still limited by the input data. This is a serious drawback in the analysis of polish patterns. At the magnifications commonly used in polish identification (200x to 500x) the incident light microscope has severe limitations of depth of focus. The nature of the material studied is such that it is not common to be able to get a large area of polish into focus at one time (curvature of tool, curvature of edge and internal curvature). In addition the local texture of the raw material is such that within the plane in focus, only a narrow band is properly focussed. These problems vary in severity depending on raw material and tool type, being particularly problematic with irregular tools of a coarse raw material (as, for example, most of the tools studied here) to being a lesser nuisance in regular tools of a fine raw material (for example, obsidian blades). These problems are not resolved by varying the image capture system from photography prior to digitisation to direct frame grabbing, although the latter is capable of much faster application, and reduces problems with distortion caused by going through the additional stage of film.

To overcome these problems and allow a more reliable image to be processed, a different type of microscopy is required. The one tried here was to use a Scanning Electron Microscope (SEM). This method produces a different type of image from a light microscope. As the image is based upon the pattern of electrons reflected, rather than on a beam of light, the reflectivity of a tool's surface and polish components as normally perceived is not evident. The image produced is instead based upon the microtopography of the tool. Polish patterns are evident from the associated smoothing of that microtopography. Depth of focus is massively improved. The suitability for textural analysis is very high, as the image is one of texture, not of light reflectivity. Polish areas were examined at similar magnifications to those commonly used in polish identification, for, although the SEM has far greater powers of magnification available, to use these in this type of study, rapidly produces diminishing returns, in that the area recorded for image processing becomes increasingly small, and therefore decreasingly representative of the polish pattern.

There are still problems with the SEM, many of which have been mentioned in the main text. On the practical level three are most significant. First is the availability of SEMs. They are certainly not available in the field, which can be a problem in countries where the export of artefacts is a problem. Even at the

analyst's base, access may well be restricted, as such facilities are frequently over-subscribed. Second is the cost of SEM use. The operating costs of an SEM are high, and are in current circumstances increasingly being passed directly on to the users. It is essential that the value of the study should be sufficient to allow these costs to be incurred, and unfortunately, a large representative study would involve high costs. Third is the problem of the small chamber size in most SEMs. This restricts the analyst to study either very small tools (a limitation of a maximum dimension of c. 3cm being common), to breaking artefacts, obviously problematic, or to making casts. The most common solution would have to be the last option. This does of course remove the image processing one step further from the original, and may involve the study of negative images. In the present study both acetate peels (a cheap and quick casting method, although not the finest quality casts) and small tools (mostly microliths) were studied.

On the image processing side there are the same problems which come from light microscopy. Although the depth of focus problem is entirely removed, the principle of a focussed beam, whether it be electrons or light remains the same. This means that there is still distortion around the edges of the image, and that the image is still very much an artefact of the angle at which the beam hits it and is reflected back from it.

The relatively new techniques of laser microscopy, saving on preparation, and giving very good results for textural analysis, were unfortunately as yet unavailable for this study.

Polish Problems

The problems with the use of polish as a key item in functional analysis have been discussed above. Assuming here that there may be different and diagnostic polish pattern development, there remain serious problems specific to image processing. They can be summarised here as:

- 1) Polish texture is, in part, a function of the local texture of the raw material on which the polish has developed.
- 2) On the tools studied here, both archaeological and experimental pieces, widely varying polishes appeared in different parts of the same tool, a problem that has been appreciated by other workers. (Moss 1983, Grace 1985)
- 3) The time, or length of use variable, presence of moisture, presence of abrasive, manner of use (including motion and pressure) all affect polish development, producing a very large range of polish pattern developments, many of which appear to overlap, if not actually duplicate each other.
- 4) The form of the tool, both its gross morphology (general curvature of edge, general angle of edge) and local morphological variations (local changes in curvature, local changes in edge angle, both of which can change during tool use due to edge damage) affects the polish pattern.

These problems all make the use of an image processing technique a very involved process. Problem (1) can possibly be moderated with a comparative set of unused areas of the same texture used as a control for each polished area, but needs to be done for *each* texture variation. Problem (2) can only be examined by an increased sample, taking in all the various polish patterns on each tool and testing for "useful" patterns amongst this range. Problem (3) again involves the use of an increased sample to examine all of these variables. Problem (4) is, fortunately, covered by the suggested solutions to problems (1), (2) and (3).

To do an adequate study it would therefore be essential to use a massive number of sample images. The cost of this, including SEM costs, computing time costs, and working time costs would be substantial, and represent an unrealistic research project. To this is added the problem that the process becomes for routine work very long and costly. It is extremely unlikely that the technique could, at present, be used as anything other than a tool for the

abstract investigation of polish patterns, and not as a routine method of tool functional analysis. Given this, and the problems with polish identification discussed in depth in the section on functional analysis theory, which make it appear unlikely that much useful information would be produced by this technique, it becomes impossible to justify a continuation of this work.

An assessment of Grace's work

One important paper on the use of image processing techniques in functional analysis has been produced by Grace, Graham and Newcomer (1985). This paper sets out a method for quantifying polishes, and attempting to differentiate between them using a statistic of coarseness of texture based upon co-occurrence matrices calculated from the occurrence of grey level combinations at set distance and direction, and the homogeneity of the image (ASM). Results are plotted as a graph with the CON (concentration statistic) against the ASM statistic. Further detail is provided on the research in a paper by Newcomer, Grace and Unger-Hamilton (Newcomer et al 1986). There are a number of points arising from their paper that are of great relevance to this discussion.

Grace states that: "Texture may be represented by the distribution of tone in the image, because in a two-dimensional image we perceive texture as the spatial relationship of different tones. Where there is little tonal variation in an image the texture is perceived as smooth; where tonal variation between discrete features is marked, the texture is coarser." (Grace et al 1985: 113) The main problem with this statement is that in their study photographs from a light microscope were used. The problems with light microscopy with regard to image processing have been mentioned above. Many of the users of the "High Powered" approach have pointed out differences in polish patterns by focussing up and down to perceive the three-dimensionality of a polish pattern (domed, flat, etc). The technique used by Grace loses this information, and the blurring of detail caused by the short depth of focus of a light microscope tends to reduce textural differences. The expressed hope of using a frame grabber to remove the problem of film sensitivity as stated above does not solve this problem.

The example given of sandstone texture classification (Haralick, Shanmugan and Dinstein 1973) appears suitable, in that it is based upon photomicrographs; unfortunately, as it is based on sandstone thin sections, it does not suffer from the depth of focus problem. In addition as the texture of the sandstone through any one plane is assumed to represent the texture throughout the sandstone, the problem of three-dimensionality encountered in polish identification can be ignored. Polish surface texture is important precisely because it differs from the normal material structural texture.

The other serious problem that arises from this paper is that it is not entirely clear what Grace was measuring. He mentions photographs taken of polishes at 200 magnifications, and that as "the differences between textures of different polishes were most evident at a small scale" (Grace et al: 114) the statistics calculated "represent combinations of grey levels from 0.25 to 1"m apart on the flint surface..." (ibid p114). However he does not locate these areas to show how the textures examined appear. It is not clear whether this area refers to an area of simple polish, whether it includes any of the internal features, such as pitting, found in polish, whether it is an average of polished and unpolished surface

between polish sections, or whether it is the boundary between polished and unpolished surfaces.

The photographs in the 1985 paper do not show any marked development of polish. Plate 1a was used on wood for only 9 minutes, producing very little polish. Plate 1b was used for a longer period, 28 minutes, but on meat, well known for not producing wear traces of any kind. Plate 1c is of unused flint. It is not surprising that these three surfaces do not appear differentiated by textural analysis. The photographs in the 1986 paper (Newcomer et al 1986: Fig 3 p209) show two different areas of the same tool, used to saw wood for 15 minutes. The overall images are very different, one showing a larger and apparently more developed polish than the other. It is again not clear where the analysed section of the prints is located. It is also not clear where on the tool the photographs come from (how much "polish" against unaltered flint is included, etc), or which is the more representative of the wear found on the tool. The fact that differing degrees of polish exist on the same tool is well accounted for and the differences in texture should therefore not be seen as surprising.

A further problem may be that the sample area size may be too small to pick up the information that could lead to polish differentiation, and may be picking up too much of the background noise of the raw material surface (Moss 1987). As mentioned above, functional analysts who use polish as the prime data do not simply look at minute polish parts, but at the area of polish as a whole, and its location on the tool.

Grace et al (1988), in answer to criticisms of Moss (1987) and Bamforth (1988) make it clear that the spot size examined is very small, but many of the above criticisms remain valid. It is still unclear what the individual locales sampled were like. From the scattergrams presented it would appear that the overall number of samples analysed was very small, making such numerical analysis less reliable. Although Grace is correct in pointing out the ability of computer analysis of digitised images to find and compare details not visible to the eye, it is not clear if the spot sizes are too small to include all the discriminating textural information. The fact that all the polish tested by the textural analysis had first to be *selected* by Grace leaves it unclear how random or representative that selection process was.

While the conclusions of the authors agree with many made in this paper, the image processing study that these conclusions are based on, can be seen to have a number of inherent problems, that make the results less useful in the debate on the usefulness of polish 'types' than they appear. These problems are precisely the reason why any image processing work needs to involve a very large test programme, to not only find a method that works, but one which is actually trying to measure something useful.

Possible uses for the methods of image processing

While there are a number of very serious problems in the use of image processing techniques, there are also some potentially practical uses. As suggested above in the section on the theory of functional analysis, there are times when a high level of analysis

may be important and may justify the methods used. One application might be the analysis of sickle blades, as in Unger-Hamilton's work on examining the internal variation of polish patterns. Here the areas of polish are large, relatively easily sampled, and the problem is a restricted one, reducing the number of tests that have to be made. The question would still remain as to whether it would be worth examining the tools with this method, as Unger-Hamilton's study is based upon differences in polish patterns already perceived. An interesting development of the technique is the hope of being able to analyse polish as a continuous rather than a discrete variable (Grace et al 1988: 229).

Conclusion

Although it was hoped initially that image processing techniques could be useful, and much time was spent on this research, it is now felt that the process cannot be justified in the context of the material used in this study. The decision to concentrate on a pragmatic approach that could be used as a routine analytical tool was a primary reason for the initiation of the image processing study, and it is as a result of this pragmatic approach that the image processing work was stopped, at least for the present.